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let Halley Flyby Mission

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mission to Halley should be designed to maximize the e in terms of the objectives of the comet exploration on eat down by the NASA Comet Science Working and the Space Science Board (Report of the Comet is Working Group, NASA TM 80543, 1979; Strategy Exploration of Primitive Solar System Bodies—Asteromets, and Meteoraids: 1980–1990, Committee on try and Lunar Exploration, Space Science Board, 13ton, DC, 1980). In order of priority, thase objectives

o letermine the chemical nature and physical atructure fru nuclei and to cherecterize the changes that occur as ar of time and orbital position;

heracterize the chemical and physical nature of the teveres and ionospheree of comete, as well as the prodrivat occur in them, and to characterize the developik he etmospheres and ionospheres as functions of n orbital position; and

n Jatermine the nature of comet talls and of the proit? which they are lormed and to characterize the init of comets with the solar wind. It redicular context of a Halley mission, these can

q it es loilowe:

atermine the appearance of the nucleus of Comet
Inlar (a) size and shape, (b) atructure, (c) hetero-

termine the chemical composition and physical and nonvolatile material amitted by

Hactarize the processee that occur in bright, ective Halley and new comets), including (a) chemical, and plasma processes in the atmosphere and iono-

(b) dynamics of dust and ice grains; (c) interaction in the solar wind and the come; and (d) structure and in the talls.



'ANSACTIONS, AMERICAN GEOPHYSICAL UNION

Flor: A. F. Spilheue, Jr.; Associate Editors: Claude J. Allegre, Peter M. Kevin C. Burke, Krielins Ketesnos, Garerd Lachapelle, Christopher T. sell, Richard A. Smith, Bean C. Solomon, Carl Kiesinger; News-Writer: Jera T. Shore; EOS Preduction Staffs Sandre R. Merke, editor's assister's Gardeon, copy editor; Oas Sung Kim, senior isyout ertist; Patricle and Margaret W. Consiley, layout artists.

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Cever. This imags of the terrein of the conferminous United States was composed by an Optronics system from about 550,000 verege sisvation points provided by the U.S. Department of Decrease. A contour interval of 121 m was used between 15- and 500-m levation, and one of 819 m above that alevation. The outline of the onterminous United States is not precise because the contours being at an attitude of 15 m.

Well-known geologic features like the Missiasippi Embayment, the Snaka River Plain, the Basin and Range, and verious mountain ranges are reedily recognizable. Of perhaps greater interest are leatures and cheracteristica not previously recognized or reported in the literature. For example, an arcusta zona that includes Lakes Ontario and Erle axtends from the St. Lawrence Valley to the west border of Michigan, it corresponds approximately to part of e predicted zone of brittle deformation caused by the Plaistocena ice load. The highlands of the westam United States exhibit e blocklike outlins to the north and east, being delimited by a boundary extending from south central Texas to northeast lows and thence west to the Olympke Peninsulia of Washington. The east boundary is the dividing line between typical eastern and wastem topographic expression; it is also the approximate location of askimicity associated with the Nemoha Line.

approximate location of asismicity associated with the Nemene Upith. The central and southern Appalachians show a surprisingly an gular outline, particularly in contrast to the Appalachian features of the northeast. Much of the complex structure of the west coast of the United States is clearly depicted. Analysis of terrain data of the essiem United States suggest a correlation between regions of seismici-

In Third States is clearly depicted. Analyses of terrain data of the easile of this states suggest a correlation between regions of seismicity and cartain of the terrain is shown to approximately 1:30,000,000. The scale of the imap that is shown to approximately 1:30,000,000 show many in the scale of the map complied at scales as large as 1:1,000,000 show many in the features, usually extensive linear trans to raise of terrain of districtive morphology. These teatures are thought to be surface as pressions of underlying geologic structures. The digital tarrain details are anew and virtually unexposited information source and should be useful in a wide variety of sain solence investigations. (Broto pour

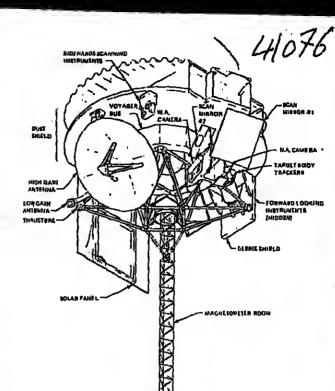


Fig. 1. The Halley Intercept Mission epacecraft,

These aims leed to a number of prectical requirements on any mission to Halley:

 Accurate targeting of the spacecraft to a preselected point within the zone of parent molecules next to the nucleus.
 Good imaging of the nucleus.

(3) An 'observatory phase' during which imaging of the tall and come at progressively increasing spatial resolutions will be obtained.

(4) Sufficiently long observation time for in sliu measure-

ments to cover the luli 107-km scale of phenomena at Halley.
The Halley intercept Miselon is based on a three exis-stabillized spacecraft. This allows significantly better imaging
than can be achieved with most spinning spacecraft. A traming camera on a fixed-stitlude spacecraft is the best meens
of achieving an observatory phase during which sequences
of pictures are taken of the comet's tails and extended coma.
Furthamore, with a framing camera, onboard optical naviga-

Helley Intercept Mission Typical Peyload

- Instrument	Maas, kg	Power, W	Data, kbps
Neutral mass epectrometer	9	5	2
ion mass/velocity spectrometer	7	11	3
Electron analyzer	4	3	2
Magnatomatar	3	5	ĩ
Plasma weve analyzer	4	7	i
Quet composition enelyzer	11	12	3
Oust counter	3	3	ī
Remote sensor	12	8	2
Subtotal	50	54	15
tmaging	79	39	90
Total	129	92	105

tion can deliver the epacecraft to the selected point in the target plane with an accuracy of ± 90 km (1 σ); the most optimistic astimate of delivery accuracy without onboard navigation la ± 500 km (Glotto). With optical navigation, it is thus possible to make eura the epacecraft passes through the zone of parent molecules which axtende -10^3 km from the nucleus, on the eurift elde, at a great anough distance to evoid emear in the highest resolution pictures.

-- FOR HAL RO HA I HELY U, 1001 F.

The Hallay Intarcept spacecraft (see figure) has a total mase of ~1600 kg, of which 300-400 kg will be allotted to the duel chiald end ~125 kg to the science payload. A possible science payload is summarized in the teble.

Halley goes through perihelion (0.8 AU) on Fabruary 9, 1986. A major advantage of the Halley intercapt Miselon is that it can intercept the comet either before or after perihelion.—PMB 88

Earth Radiation Budget Satellite

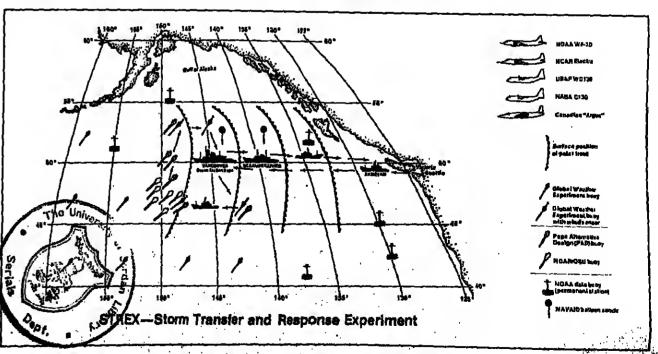
A satellite to measure the aerth's radiation budget is to be integrated, tested, and delivered ready for launch on tha epace shuffle by April 1984. Although there have been Earth radiation budget instrumenta in NASA's exparimental NfM-BUS 6 and 7 epacecraft, this will be the first time this factor can be measured on a globel basis over a 24-hour dey. The earth absorbs more solar energy in some regions and emite more thermal energy in others. This heating differential sats wind and ocean currents in motion to translar heat from heated to cooled areas. Hance, the earth's radiation budget, as a driving force for weather, is one of the factors on which comprehensive data are needed for better weether and climate predictions.

The salelille, with its Earth Radiation Budget Experiment Instruments, will become part of a threa-speceraft system, with NOAA-F and -G, to use scanning and nonscanning radiomelers to measure the amount of solar radiation received and given up by different regions of the eerlin. The satallite will include systems for power, command end date handling, attitude control (three-exis stabilized), orbit adjust, es well as a thermal control. The spacecraft will communicate via the Tracking Data and Relay Satellite System. Alter faunch by the space shuttle, the satellite will boost liself into a 600-km (373-mile) circuler orbit, inclined 46° to the equator.

The Bell Aerospace Systems Division of Ball Corp., Boulder, Coloredo, will provide the Earth Radiation Budget Satellite as well as its mission operations support. The contractor's proposed estimate of this cost-plus-eward lae contract is epproximately \$21 million.—PMB &

Status of Voyager Spacacraft: Update

	Voyager 1	Voyeger 2
Spacecreft diatence from Earth, km	1,449,237,000	,1,194,439,000
Spacecraft distance to Saturn, km		221,532,000
Spacecrett distance travaled since launch, km	2,294,300,000	1,964,094,000
Spacecreft valocity ralative to Earth, km/a	28.9	20.5
Spacecraft velocity relative to aun, km/a	21.5	19.4



STREX: Winter Storm Study in Quif of Alaska

U.S. end Caredian investigators are probing the initial stages of the large etorms that dominate North American winter weather. In a study balled STREX (Storm Transfer and Response Experiment), researchers aboard ships and alroratt are examining how energy and water vapor faed from ocean to etmosphere. This action fuels the large storms that rage across the Gulf of Alaska. The low-pressure systems drift ashore in western Canada and the Pacific Northwest, break up over the Rockies, and then reform into major sys-

raga soroes the Gulf of Alaska. The low-pressure systems drift ashore in western Canada and the Pacific Northwest, break up over the Rockies, and their reform into major systems that control will terweather from Canada to Texas.

"It is believed that new raights this such disturbances will improve weather predictions and lead to a batter understanding of the North Alignifican climate. The experiment is man-

spheric Environment Service. A STREX project office in Seetile will be used to coordinate the 6-week study. (Other STREX participants include the National Science Foundation, National Center for Almospheric Research, National Aeronautics and Space Administration, U.S. Air Force, Office of Navai Research, U.S. and Canadian Coast Guards, Canada's Inatitute for Ocean Sciences, and Oregon State University.)

During the experiment, research ehips, alded by bury's deployed in the path of the storm, will take measurements from below the sea surface to incusaride of feet in the air. Also, research airplanes will probe the advancing storm fronts. As many as 10 storms enough crose the Gulf of Alaska during the experiment, which ends in mid-December. STREX goals include improved weather forecasts and

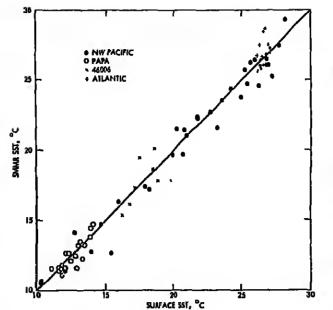
Sea Surface Temperature Measurements from SEASAT

In its short lifetime, the SEASAT Scanning Multichennel Microweve Radiomster (SMMR) observed the world's oceans for almost 100 days in the summar of 1978. This wes dona in ordar to determine see surface temperature (SST), wind spasd et the ocean'a auriece, rain rats, and the integrated column dansity of wetsr vapor and ifquid weter in the elmosphera. Thasa perametere ere deduced from me esurements of both horizontal and verticet polarizations of radietion et five microwave frequencies trom S.S to 37 GHz.

SEASAT was e 'proof of concept' sateliite to determine how accurately microwave sensors could meesure important parameters of the oceane. The SST measurements examined so fer are ancouraging. They have been compered to nearly 100 high-quality surfeca observations under a variety of conditions and have been found to possess a negligible bias end to be accurate to within 1° over a wide range of values (10°-30°C).

The comparisons heve been made in four major geographicel areas: the northwest Pecific, the Guif of Afeaka, the tropical western Pecitic, end the western Atlantic neer Bermuda. The results are shown in the tigure. The scatter about the perfect agreement line ie 0.8°C, and an arror analysis shows that most of the scettar le dua to thermal noise in the maeeuremente and not to errors in geophysical modeling.

There are several limitations that must presently be accapted in order to schlove better than 1° eccuracy. The most serious ona is thet meneutemente must be reetricted to the open ocean-targo tand masses within 800 km blas the SST retrievale. Atso, radio fraquency interferonca, eungiint, and heavy rein sometimes degrado the meesurements. Fortunaialy, these restrictions only affect a smeil percantage of the entire deta eet. Furthermore, it may be possible to improve tha algorithms so that they obtain accurate SST retrievale in



epita of these restrictions. In eny case, it is becoming increasing clear that not only hes SEASAT fultilled its goel of validating the accuracy of microwave remote sensing but elso that the SEASAT data set itself should prove to be a valueble resource for geophysical investigations.

Further comparisons to accurate surface observations are desired, aspecially in erees of the world not yet examined. Anyone with accass to accurate SST observations made at least 300 km from large tend massas during July-October 1978 ers ancoureged to communicate with Thomas J. Chestsr, JPL 238-420, Pssedena, Cslifomla 91109.

Dr. Chester of the Jat Propulsion Leboratory is the contributor of this news item. \$

Radon: Ciue to Earthquake Magnitude

Radon's tiow within the eerth's crust could offer seismot giste clues about the magnitude of an impanding earthque according to a model proposed by Robert L. Flaischer General Electric Company physicist, at the AGU Fell Mis last month. His work suggests that an extensive natw redon monitoring stetlons would be useful for early vof potential demegs ere ee of the pending fremore.

Small emounts of radon, e ges released by the dack uranium, tends to move elowly within the earth'e crust your rocks are relatively porous. Valocitiee oi e taw inches are typical. Shifting stresses in the earth's crust the an eerthqueke cen spead up or slow down radon's *:

Eerthquekes registering low on the Richtsracelee... stresses on the earth's crust only strong enough to still inaffact redon flow in rocks, says Fielschar. These smarcore impact redon's flow over reistively short distences ger cordingly, stronger quekes heve e greater impect ov:

For exemple, Fielscher's calculations show that contract reting 5 on the Richter scele should not influent more then 98 km eway. A major eerthquake, euch? 1979 Alesken queke, measuring 7.7, could effect review out to 3860 km.

The model proposed by Fleischer is based on a do :model and on the essumption that crustsfatress inci with eerinqueke megnitude. He reports good corret: tween the model and recorded fluctuations of redon: sienprevious aarthquakss. A eimiler modet used by Sov, tists shows similar correlations with other data.-- BT2 ...

ar enicely balenced account of how one goss about measuring and interpreting physical oceenographic deta.

Chapler 7, "Circulation and Water Masses of the Oceans" (85 pages), sithough briafer then its companion chapter in Sverdrug, Johnson, and Fleming's The Ocsans, is of course considerably more up to deta. Pickard hae schleved e measure of brevity by Intentionally neglecting petipheral regions and by smphasizing modern research in the principal ocean hasins. Although there is a waelth of reesonebly accurate datall in this chapter, the interested reader will tind it difficult to obtain more informetion because the sources ere not cited.

The final two chapters end the eppendix briefly outline coastal and satuering oceanography, suggest future work. and discuss physical ocaenogrephic units (20 pagas total). An annotated list of suggested reedings completes the text.

The revisions ere in the same 'cut and paste' etyle used in the previous adition. This may raduce arrors, but does not aliminsts them. At least two errors were introduced with the changs to Si units, end severel other arrors either persist from past aditions or ere introduced here. All errors ers minor and should cause little confusion.

This text represents e comprehensive subject covared by few pages; hence certain topics ere slighted. I missed the development of a historical parapactive (only very briefly outlined) and the use of appropriete mathematics. While the nonmalhematical approach will parhaps avoid trightening tha nonphysicists, and while most of the assential mathematics iscovered at an eppropriate level in the compenion voluma (Pondand Pickerd's introductory Dynemic Oceanography), the bookwould have benefits d from a discussion of the quasi-mathematicei aspects of the distribution of verisbles.

Also, there has been no increase in the third edition in the use of ligures to illustrate the text. Most sections would great-

ly benefit from an increased use of grephics. My stronges riticism is that the oceanographic literature is not properly cited. Thus the student who wishes to learn more about specific subjects cennot use this book as e starting point. Proper literature citetions would add little isngth to the text, would not be confusing, and would greetly increase the usafulnese and value of the text. I would cite Perry and Walker's The Ocean-Atmosphere System as en example of e related text which presents e batter historicai perspective, contains appropriete mathematical development, usss ample graphics, and providae proper literature citations, yst achievss this without becoming inaccessibis to the nonmalor.

The third solition doss, however, continue the evolution of Pickard's text into a much-nasded niche in the ocaanographic iltereture. The book doas not accomplish sverything one might hope, end in particuler is wask on its own for introductory courses for physical oceanography majors, but t feel it is very nearly the best that can be done within so few

The value of this book is that it provides in one brief, wellwritten volume the rudiments of physical ocsanographic aspecte of water mess energysis, along with the interences such analysis provides of the cheracteristics end circulation of the oceans. This is an important subject not well discussed in most other taxts in recent yeers. I would recommand this book to any person wishing e siraightforward introduction to the eublect. Greduste students from eli ocsanogrephic disciplines may well find it to be sesential reading prior to general examinations.

James H. Swift is with the Merine Life Research Group, Scripps institution of Oceanography, Le Jolle, Celifornia.

AGU Congressional Science Fellowship

The individual selected will spend a year on the staff of a congressional committee or a House or Senate member, advising on a wide range of scientific issues as they pertain to public policy questions.

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The fellowship carries with it a stipend of up to \$25,000 plus travet allowances.

interested candidates should submit a letter of Intent. a curriculum vitae, and three letters of recommendation to AGU. For further details, write Member Programs Division, Congressional Fellowship Program, American Geophysical Union, 2000 Fforida Avenue, N.W., Washington,

Deadline: March 31, 1981.

HE LINIVERSITY OF JORDAN AGE, NO. 41076

New Publications

Modeling and Control of River Quality S. Rineldt, R. Soncini-Sesse, H. Stahlest, and H. Tsmura, McGrew-Hill Ser. in Weter Resour, and Environ, Eng., McGrew-Hitl, New York, xiv + 380 pp., 1979, \$49.50.

Raviewed by Kennath J. Lanfaar

This book is a major work in the field of mathametical water quality modaling, providing an in-dapth treatment of modaling end control techniquas.

Chepter 1 is a meficulous and comprehensive discussion of modeling theory and tarminology. Equations are expressed in a metrix notetion which is employed consistently throughout the book and provas to be a powerful vehicls for presenting compilcated models in an understandable manner. Chapters 2 and 3 axamine water pollution processes and quelity indicators and the different components of water quality models. Emphasis is on the forms of the various equations, rather than on the specitic peremeter values. Chapter 4 ties the earlier chapters together by looking at the construction of aelf-purification models, particularly the Streeter-Phelps model and Ita varietions. Also intereating is a section on ecological models using Michaetis-Menton reletionships

The strength of the book is clearly in its prasentation of modeling theory. By using its concise matrix notation, it provides excettent explanetions of how such affects as photosynthesis and dietributed BOD loedings are incorporated into model equetions. Some waaknessas on the practicel side are evident. For example, in discussing weys to estimate the receretion coefficient, only river depth end velocity are considered, ignoring recent iormulatione based upon enargy dissipetion.

Cheptar 5, 'Slate end Parameter Estimetion,' prasents e major espect of the book's modeling philosophy: Establish the modeling equations, then datermine the perameters of these equetions on the baets of observatione of the eyetem output. This is a sound technique, provided that peet observatione are appropriete for predicting future systam performanca. It also explains why the book devotes relatively little space to more conventional methods of estimeting paramatar vatues. The modeling philosophy wfii not apply, however, where auch actions as stream channalization or drastic aitarations of waste loadings cause the hydraulic or biologicai perameters to chenge.

One axample in chapter 5 of a Sirecter-Phatos model of the Bormida River to tiluetrative of the book's strength in modaling theory and weakness in practical application. in a demonstration of akiltfully applied mathematica, the modal equations were manipulated until a ona-dimansionat searching algorithm could be applied to astimate the paramaters. However, no correction was made for the diesolvad oxygen becoming zoro (and changing the deoxygenation coafficiant) in some of the calibration data sate. The resulting predictions of minimum dissolved oxygen are unimpressive, considering the abundance of celtbration data. Chapter 5 presants even more advanced techniques. auch ea Kelman fillers, auboptimat recursive filters, and recursiva lilitera in time and apace, but some of thasa ara teetad againet synthefic model data, not fiald data.

The final five chaptara cover auch topics ae control theory, linear and nonlinear programing, unsteady atata controf, water pollution confrof facilities, river basin management, and multiobjective programing in each of these, the approach is to formulate the problems and to discuse briefly the aveilable sofution techniques. In this way, an extensive amount of

useful material on theory to covered without excessive amphasis on details.

This book is definitely not for the casuel reader. Undaretanding it takes time, concentration, and a ressonably soitd background in methematics, I would highly recommand it, however, to students of advanced wetst quelity modeling and to practitioners tecing difficult modeling situations that require advanced techniques.

Kennath Lanfast is with the Rasaerch and Treining Brench, Environmentel Affeks Office, U.S. Gaological Survey, Reston, Virginte.

Geology for Civil Engineers A. C. McLaan and C. D. Gribbie, Alien and Unwin, Winchester, Mess., xvili + 310 pp., 1979, \$25.00.

Reviswed by Iven C. James Ii

A course in angineering goology was not offered the semester that I wanted to take it so I took the introductory geology course. I have always suspected that t had miseed assimilating those megicel formulas of rock mechanice, tunneiling, and dewetering that the aspiring civit engineer dreems of using to speed his project through difficult terrain. McLean and Gribbis have teken an alternative epproach. Their book is not angineering geology nor is it just introductory geology, but they ley claim to geotogy for civil engineers ee suggested by their choice of title. My impression is that they have written four chapters of geology tollowed by four cheptere of engineering geology.

This is e distinctly British book with amphesis on giaclal morphology, the use of tarminology which may be unfamilier to North American practitioners (e.g., greenfield sites, dumb wells, tinite reservee, etc.), and tha application to predominently British field examples. Reterances to the British Code of Prectice and citations of information sources ara elso much more suited to the British student or practicing

On the whole, this book is readable, well presented, and appropriate for an introductory samestar or quarter course in the subject. A strength of the book is the introduction of tarminology in boidtaca type with the definition in context. This, coupled with a good index, should sid the practicing angineer teced with tarms unfamilier to his normei vocebulary. A lack of belence axlets between some chapters as examplitled by the ettention given to formulas in applied geophysica, McLean's specialty, and the lack of virtually any discusation of computational or analytical mathods in tha chapter on subsurface water. Although one example to the Inattention to the units appropriate for the formula for aubsidanca found on page 189, mietakss appear to be faw.

'Ivan C. James It is the District Chief for New England, U.S. Geological Survey, Boston, Massachusatts.

Descriptive Physical Oceanography G. L. Pickard, Pergamon, New York, Ix + 233 pp., 1979,

Raviewed by Jamea H. Swift

This new edition of G. L. Pickerd's anjoyable text, published only 4 years after its predecessor, shows continued improvement over the original edition. Not only are most topics brought up to date but also the book is slightly more com-

prehensive, and thus it is more nearly representative arn deep-saa synoptic physicsl oceenogrephy. The & '3rd (Si) Edition' is somewhet misleading, since few o ravisions ere raieted to the minor metter of convereic

The overall organization of the text remains the sarties -though the page count has grown elightly. The first to tars introduce the suthor's epproach to his aubject, or the general nature of the ocean basins, define the imp physical properties of seaweter, and describe their typdistributions (47 pages total). The heart of the book, c::.. ing three-fourths of its pages, is found within the next chapiers.

Chapter 5, 'Weter, Salt and He et Budgets of the Oce-(27 pegss), is a fine introduction to the definitions of the oue terms in the most common mass end heet budget equi tions. The regional variations in the individual components are not illustrated. This is unfortunate because such tique would make this e firet-rats chapter. The budgets them se-(i.e., the combination of the various ferms) era only briefly mentioned, and then in global form only.

Chepter 6, 'instruments end Methods' (43 pegss), is a. gem. The instrumentation most common to physical oceitgraphic tleid work is nicely covered, and there is some c cussion of the relative merits of the various techniques. Moreover, this has been combined with an affort to demoi a etrats how the inferents of physical oceanographers have motivated the most common interpretative methods. The chapter is in no wey a field menual, but it does give the reed-

noaa atlas 3

THE CENTRAL NORTH ATLANTIC OCEAN BASIN AND CONTINENTAL MARGINS: GEOLOGY, GEOPHYSICS, GEOCHEMISTRY, AND

> TRANS-ATLANTIC GEOTRAVERSE (TAG) BY PETER A. RONA, NOAA

- 21 MAPS (LATITUDE TO N to Se No
- BOILON PHOTOGRAPHIC TRAVERSE
- SESSIVE PERACTION SECTIONS . STILMIC REFLECTION PROFILES
- · 12 GEOFAVERSES (BATHYMETRY GRAVILY MAGNETICS)
- . PITTSICAL AND CHEMICAL PROPERTIES OF CRIEST
- United Springer (1) - INST-OGSAPHY
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Intergovernmental Personnel Assign-menta/Office of Surface Mining. The Depart-ment of the Interior anticipates a few openings for languary appointments of earth scientists during 1981 or 1982. The assignments would involve a da-tal from the sciential's present amplitude yet for one or the same. The present amplitude participate of State or two years. The present employer must be e State or local governmental arity (including state universities). The assignment would be with the Technical Analysis and Research Division of the Region V Office in Denvice. Colorado er with one of the Wastern States manufactures. State's regulatory offices. Principal solvities would involve scivilical and environmental reviews of delated proposals to mins coal and recialm disturbed sons and recialm disturbed sons and recialm disturbed. ands and provision of lephnical assistance to coal

 Provision of lectricial assistance in the personnel.

My operators and regulatory egancy personnel.

Individuals in the following disciplines are needed:

L. Hydrology—emphasis on quantitative self-mailton of physical and chemical effects of the personnel. ining and reciamation on the hydrologic hysiem. Development of systems approach o satimating the ounculative hydrologic ef-acts of site-specific and regional mining. Mining Engineering—emphisals on com-partson of mining techniques to recover addional coel and to reduce environmental afacts, prediction of subsidence over under-

devernent of approximeta original con-Amospheric Science—emphasis on predic-tive modelling of fugitive dust sources and

ind mines; and astimation of

Geological Engineering—emphasis on ex-ploration geophysics (a ach as shallow esis-mic, resistivity, well log interpretations, soil and rock mechanics, and blasting (for min-ion)

oses of the aseignments are to assist the

Citic of Surface Mining, and state regulatory authorities in the review of mining and rectamation plans for the extention of coal from federal lands and in envitesesements of such plans.
These assignments are intended to provide the whith experience and understanding of the likeling Control and Reclamation Act and rebear and state elatutes and regulations in or-to improve his effectiveness upon return to his

seignment. and local agencies and educational instituand local agencies and education as implication as encouraged to contact the Office of Survival, Coloredo 80202 (After John Hardwey, 164 Micel Analysis and Research Olylabri) with perferent life and letterage in the lateral life and letterage in the lateral life. design information regarding skills and interest. In-additions of interest are encouraged as according to the Scientista must meet conflict of interest re-stancing adopted by the Office of Surface Mining. The Department is an equal opportunity employed. Research Associate Position. The Geophysics Program at the University of Washington seeks applicants for a research associate position in space physics, beginning June 1881. The position is sup-ported by research contracts and grante. The applifracts and giante. The appli cani should have a Ph. O. and be experienced in Xray and charged particle detector techniques as aped to apace and autoral research, in addition to heving good background in space plasms phenome-ns, interested persons should send their resumes to leorge K. Perks, Gaophysics Program AK-50, Uni-ersity of Washington, Seattle, WA 98195. The University of Washington is an equal opportu-

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Institute of Space and Atmospheric Studies University of Szekatchewan. Applications are invited for posidoctoral research positions in auroial physics and almospheric dynamics. Term is one year renewable, Experimental ability or ex-perience with optical or radio techniques is desirable Work may Involve rockel; belicon or observatory measurements and their interpretation. Sand resume. reletencee and research interests to: O. J. McEwan, institute of Space and Almospheric Studias, Univer-sity of Saskatchewan, Saskatoon, Canada 57N OWO.

Yale University, Department of Geology and Geophysics. Applications are solicited to a faculty position in petrotogy or mineralogy to begin in the academic year 1981 - 1982, Areas of special interest to the department include theoretical and ax-pertmental mineralogy, petrology, and field studies. Yels University is an equal opportunity/attimative

action employer and encourages women and mem-bers of infrontly groups to compete for this position. Curriculum vites, publications, and the names of three or more reference should be sent by January 31, 1981, to Robert 8. Gordon, Chalman, Department of Reclogy and Geophysics, P.O. Box 8868, New

Associate Director/Marine Science Insti-tute. The University of Texas of Austin seeks to fill the open position of associate director of the Marine the open position or associate director of the wants science intellities. The associate director is responsible for research and intellicetual leadership of the institute's Galveston Geophysics Laboratory. The position carries the line responsibility of senior administrator for the Gelveston Geophysics Laboratory. Duties include research planning and management and shop operations, administrative supervision, lialson with industrial and agency sponsors, represente

tion and other directorahip duties.

The Galveston Geophysica Laboratory maintains modern computing tacilities, research laboratories, research vessels, the RIV Fred Moore and the R/V Ide Orsen, Research at Gelveston include programs in merine geophysics, marine geology, solid suth geophysics, sarthquake and ex-iral-arrestrial selsmology, and instrument systems design, both basic and applied.

tanta are saked to send the following: (1) Vita—including list of publicetions.
(2) Brief statement on current research and

(3) Orief statement on administrative experi-Brist stelement on teaching experience.

Names of six persons who may be con-sacted for personal and professional rec A letter of application and the above requested in formation should be sent to:

Or J. Robert Moore, Director. Marine Science Institute University of Texas P.O. Box 7999, University Stallon

P.O. Box 7999, University Station
Austin, Texas 287.12
Salary based on qualifications. Ph.D. required.
This successful candidate will also be considered for the successful candidate will also be considered for the successful candidate will also be considered for the successful candidate. Position to be falled as according to Studies. Position advised. Position located in California to Texas.

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Rasgaroh Assistants/Utah Stata University. Excling opportunities at the frontiers of knowlstants in the Department of Electrical Engineer assistants in the Department of Electrical Engineer-ing et Ulah Stata University. USU, located at the base of the Wasatch Mountaine, its engaged in ground-breaking investigations in many chilical fields Gat involved in environmental sensing, digital accotronics, microprocessor applications, electro-optics or computer engineering. Do space and simosphe physics with state-of-the-art instrume station on the ground, in rockels, or aboard the space shuttle. Fo datalia on these and other projects, contact Doron J. Baker, Haad, Department of Electrical Engineering,

UMC 41E, Ulah Siala University, Logen, UT 84332 [lelaphona: 801/750-2840]. USU provides opportur

tias based only upon parlormence.

University of Hawaii. The Cepartment of Ceology and Geophysics of the University of Hawait is seeking applicants for element track position, beginning July 1, 1981, in either of the following helds: (1) lectonics of ocean basins and margins, [2] pale-

Applicante should have a Ph. O. degrae and a damonstrated ability to conduct and promote marinresearch. Ability to leach at ell levels la required. The position will be a joint one on an 11-month beats with the Hawaii insidute of Geophysics. The appointment will be at the rank of assistant professor. Apply with rasuma and names of three ratarences to Saymour O. Schlenger, Chairman, Capartmant of Geology and Osophysics, University of Hewall, Honolulu, Hi 86822. Closing date is April 15, 1981.
The University of Hewell is an effirmative action/

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The Radar and Optics Division of ERIM requires a Rsdar Oceanographer, preferably at the PhD level, to function as head of the Oceanographic Measurements and Analysis Group of the EM Measurements Department. Experience as an Oceanographer including EM measurements of oceanographic phenomena is required. Experience in the msnegement of research programs is desirable. Candidetes should have knowledge of EM remote sensor systems and techniques. The EM Measurements Department conducts research programe to apply EM measurements techniques to oceanographic problems.

ERIM, a non-profit corporation, ie a center of research and development on sophleticated aensore and data processing techniques used by the Department of Defense and other agencies engaged in remote sensing.

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Send your resumé and salary requirements in confidence to John J. Malik. U.S. citizenship is required.

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Sedimentary Petrol ogist. The Geology Ospartment at the University of Vermont is seeking a aedimentary petrologist for a lenure track position at the assistant professor level. Research end teaching specializations should be in classic sadimentary petrology with potential ancillary interests in petrolaum geology, geomorphology, end hydrology. It is ox-pecied that the successful condidate will ostablish o field-oriented research program which includes aurvision el graduala (M.S.) and undergradualo siu dants. A Ph.O. is required and leaching experience is highly desirable. The Geology Department at the University of Vermoni len seven member department having an M.S. program and a definite commilment to excellence in undergradual eaducation Applications will be accepted until April 1, 1991. Candidates should send a resuma and arrenga for

three letters of reference to be sent to John C. Orake Department of Gaelegy Jniversity of Vermont

Suringion, Vermoni 95405
The University of Vermoni is an equal apportunity-

Yele University, Department of Geology and Geophysics. Applications are solicited for a faculty position in colid acrih goophysics to begin in the academic yaer 1981-1992. Aracc si interest to the department include seismology, exploration geo-physics, mechanical and physical properties of rocks

and minerals, geomagnelism, and tectonophysics.
Yale University is an equal opportunity/effirmative
action employer and encourage a women and mempers of minority groups to compote for this position Curriculum vitae, publications, and the names of hree or more referese should be sent by Jenuary 31 1981, to Robert B. Gordon, Cheirman, Department of Geology and Geophysica, P.O. Box 6666, New

Sedimentary or Low Tamperature Gaochemist. This is an assistent professor, tonur irack position, eithough exceptional cerdidates of higher rank will be considered. We see looking for a peochemist to complement our strong programe in sedimentology, hydrogaology, organic geochamis try, and basin analysis. The leaching toad to three courses per year—one beginning level geology course, an upper fevel goodhemistry course, and a graduals course of his/her cheesing. Introductory geclogy and summar field camp are elyotaught on a long-lern rotating basis. A woll-equipped laboratory outer facilities are available. The potential exists both for outside funding and for cooperativo

The successful candidate will be expected to conduct an active research program leading to pub-lications, Applicants chould submit a lotter of applicalion, resuma, a copy of each transcript, and have hree supporting letters sant to.

Department of Geology Columbia, Missaud 8521 f The University of Missourt is an equal amployment

Postdectoral Fellows/Department of Terwashington. Endowed poeldocloral fellowships In private institution, amphasizing maximum freedom of research in ereas of geophysics, isotope and trace alement geochemistry, mass apectrometry, plan-a lotogy, and star and planet formation. Ranewabte or second year. Woman and minority candidates encouraged. Comploted epplications due March t. 1991. For information write Fallowship Committee, Dept. of Terrestrial Magnetism, Camegie institution of Washington, 5241 Broad Branch Road, N.W.,

Associate Program Director/NSF. The National Science Foundation's Division of Earth Sciences is seeking qualified applicants for associate program disclor, Geophysica Program. This position is excepted from the compatitive civil service. EC-13/ 14 (equivalent to GS-13/14, \$32,048-\$49,229 per annum), and will be filled on permanent or 2-yearrotational basis. A Ph.O. in geophysics is desirable Equivalent research and experience in the adminis tration of large, multidiscp imary research programs may be substituted for a degree. A broad general knowledge of geologic research and lamilianty with the U.S. scientific community are elso required. Applicants should submit a slatemant of interest and re aume or SF-171, Personal Qualifications Statement to the National Science Foundation, Parsonnel Ad on Branch, Announcement Number EX 80-21, Rm. 212, 1800 G St., N.W. Washington, DC 50. Artn. E. Paul Broglio | Helephone: 202:357-

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Graduato Assistantships/Physics and Aatronomy. Gradualo roscaich assistantshing and leaching aggistratishing in the Dopart nori) of Physics and Astronomy of the University of luwa ara available to well-qualified sturtents The department has vigorous research progrems in spaco physics, plasma ohysics acquatics, ostronomy, astrophysics, alonic physics, elomonfury particlo physics, laser physics, nuclner physics, and solid slalo phys ica. A ssistantships cau began in June. August ut-January, Please suttress your inquity to Oopail mant of Physics and Aetronomy, The University of friwa. lown City, tA 52242.

Sedimentary Gacchamial. Princeton Univerelty seaks applicants for an assistant professoratup within the general fields of the chemistry of sedime lery systems or the genesis/diagenesis of sedimentary rocks. Further information may be obtained from avid Crarer, 609-452-4123

Submit opplications, including vita, statement of research and leaching interests, and names of three

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Sheldon Judsen, Chairman Department of Geological and Geophysical Sci-Princeton Universit

Chairpers on. The Geoscience Department, Now Maxico Institute of Mining and Technology, is seek-ing a geosciential of recognized academic and scieninic achievement for the position of chairperson. The grams through the Ph.D. In the fields of geod iry, geology, geophysics and hydrology. Oulles are to edminister the department, conduct research, direct graduata studente and instruct in sreas of interast. Ph.O. required, salary and rank open. Letter of appli cation, resuma and letters of three references should be postmerked prior to January 25, 1991 and sent to Gaesciance Opportment, New Mexico Tach, So-

Assistant Professorship/Department of Physica, University of Minneauta. Wa expect to fill a tenure track position at the essistant pro fessor level during the next two years. Priority will be given to candidates in space physics. Applicants will be judged in terms of their promise for outstending schelarship in their research arase, promise for ex cellence in teaching, end the relationship of their ro search programs to programs of the department.
Candidates should send a resume, bibliography

and statement of research interests to: Professor Welter Wayhmann, Head Donartment of Physics University of Minnes

110 Church Street, S.E. Minneepolla, Minneeola 55455 The condidate should arrange to have at least three letters of recommendation sent directly to the above address. The deadling for receipt of all materi-

ol is February 1, 1980. The University of Minnesota is an equal opportu nity educator and employer. The University specifi-celly invites and oncourages applications from warn-

Computer Specialis/University Research Environment. The University of Rhode Island is eacking on individual to help implement a Satellite Remote Sensing Softwere Package on our PRIME working in a dynamic rasearch anvironment and must be capable of managing his/har own time and of scong a project through from stert to finish. Applicant must be available immediately.

The ideal candidate will have a working knewledge of PRIME and OECRSX 1 t FORI RAN, operating

system subroutines and Assembly Lenguage, exporience with salalide romoto aonsino syste age processing systems and a degrae in computer science or softwere and/neering Applicants with an appropriate aubset at the above shills will be consid-

Salary range 12 \$ 19,310 to \$22,319 Benefits include 22 days vacation and a rursi ocaensida setting

Cellor sand resume below January 1, 1991 to Al Cutting, Graduate School of Ocaanography, Computer Cantor South Farry Fld , Narragansall, Rhode Island 02882

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Faculty Positionas Astronomy/Space Phys-ica. The Department of Astronomy of Boston University invitas applications for arear two lanura track faculty positions opening September 1991. Empheais will be praced an active research exparienca us well as interest in graduate and undergraduate teaching. We are considering good candidates from any field of astronomy or space physics. Applicants obould send resumes and the names of three references to M. O. Pepaglannis, Department of my. Boston University, Boston, MA 02215. Boston University is an equal opportunity amploy-

Postdout oral Rassarch Associata/Mineralony. Applications are invited for research in his tion and analytical transmission electron microscopy of minerals and their analogues. Experiance in crystallography, malarials eclences, or stec-tron microscopy is desireble. Send resumé i including transcripts), statement of research interests, and names of three references to P. R. Guseck, Department of Geology, Arizone State University, Tampe,

Arizona State University to an SO/AA employer

Geophysics Research Associate. Waskin Observatory of Boston College seeks MS in geo-physics (doctorate work desirable), teminarity with ime and frequency domein analytical ischingues and knowledge of FORTRAN programming. Oppor-lunity for independent research along with assigned responsibilities relating to New England seitmic net-work. Salary to \$20,000 depending on qualifications it benefits. Sand latter and resume to ion College, 140 Commonwealth Avenue, Chest-DUITED MA 02197.

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Exploration Geophysical University of Oktahome. As part of a 5-your plan of develop and axpansion, the School of Geology and Geophys cals looking for a person in form the nuclaus of an auploistion geophysics group A Ph.O. in geophysics is required, and praforence will be given to someone where toaching and research interests are in the acquisition, processing, end/ur interpretation of seismic data Presont equipment includes a truck-mounted humper energy source, capable of panalisting e kilometer or more of reck; e portable, 12-channel seismic recording System, gravimeters, magnet ters, an electrical researcht und in-house mare computers, and terminals to the University's IBM 376 eystem A geophysical observatory supports research in solid earth geophysics, and the exploision physicist would work closely with the lectorics.

sold carin geophysics group.

Applications are dise February 15, 1881. Selary is competitive with industrial standards. Inquiries and tions should be cent to John Wickham, Director, School of Geology and Geophysics. University of Oldsheme, Norman, OK 73010.

The University of Oklehoma does not discriminate on the basis of race or sex and is an equal opportu-

Faculty Position. The Department of Geology of the University of Naw Maxico ceeks applicants for a position in clay minaralogy, low-lamperolure gao chemiatry, carbonale petrology, or economic geology. The appointment may be at the assistant, asac ciala or full professor toval conlingent on approval alrongly committed to leaching at both the undergraduata and graduata levels. In addition, ha or she will be expected to develop a vigorous research pro-gram in his or her field of speciaty and will be expacted to supervise graduate students at the M.S. and Ph.O. levels. The closing date for application to April 15, 1981. Applicanta should send a résumé, ur dorgraduate and graduate transcripts, three letters o l relevance, and a brief discussion of reasarch interasia to Rodney C. Ewing, Cheiman, Ospartment of Geology, University of New Mexico, 67131. The University of New Mexico is an equal apportu-

Yirginia Polyteahnic feetitute and State University. Igneous Petrology and Geochamic lry/Research Associata. Origin and tectonic signific cance of grantic rocks. Project involves pet analytic chemistry, mineral chemistry, isotopic etuc

les, and field mapping. Send réaumée lo: O. R. Wones, Cheirman Department of Geological Sciences Virginia Poty. Inst. and St. Univ. Blacksburg, VA 24081 The University is an equal opportunity/affirmativa

Program Menager/Mateorology. Oceanographic Services, Inc., le saeking quelified ap-plicante for the position of program menager for meteorological studias. Applicante should heve an M.S. or Ph O. in meteorology or almospheric sciences, plus experience in the field. A broad genoral knowledge of air pollution, and en un-derstanding of the eir pollution regulatory environ ment, is helpful. Interested porsons about send re-sume, raterances, and celary history to R. C. Banka, Oceanographic Services, Inc., 25 Caatilian Orive, Goleta, CA 93117.

Assource/General Gealogist. The University of Peteburgh at Bradford will have a lenure track opaning for a resource or general geologist in September, 1991. This new position will serve an aplab lished two-year program in polrotourn technology and e now, geology-based, lour-year program in an-vironmental sciences. Rank and salary ere negoliable. The candidate will be expected to leach introductory eir photograph interpretetion and at least some of the following courses in the perth and enviromantal sciences program: structural geology, stratigrephy, economic geology, coal ganlogy, in ad-dition, the candidata will teach courons in the patromore in their am competible with his or her skille APh.O. end some experience ere oreterred, but applicants with other qualifications will be considered. Praterance will be given to those with

petrolaum industry axperienca. Stadford is tocated in the Allegheny Mountains in an area rich in natural and recreational resources. Please send resume and three tailors of reference to Cail Gurgchardi, Univarally of Pittsburgh at Gradford,

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Selemelegist. The State University of New York inghamton has a vacency for e selemologist of the assistant professor leval. Candidates with re me assertent protessor reval. Candidates with re-search interast in exploration geophysics or earth-quake selemology and a solid inecretical back-ground are encouraged to apply. A Ph.O. with O to 5 years of Is aching, research, and/or industrial experi-ance is appropriate for the position. Satary is respo-liable and competition with explorate feaths. liable and competitive with academic institutions. P sition is available in fall 1891. Please send regume and the namee of three references to Chairman, Geophysical Search Committee, Department of Geological Sciences, Stele University of New York

kogical Sciences, c., ghamton, NY 13901. State University of New York of Singhamton is an ifilmative action/equal opportunity amployer.

Structural Geologiat. The Department of loncegof Purdua University Invites application for a tenure track laculty position in structural geology, starting in August 1991. Rank and salary will be ations. A Ph.O. Is recommensurate with questications. A Fig. o. is re-quired. The individual will be expected to teach undergraduata and graduate coursee in atructurei geol ogy and lectonics, perticipata in summer field courses, end pursue an active rosearch program.

Preference will be given to a candidate with an eppiled field orientation and a strong background in the quantitative enalysis of field date. The department has active programs in petrology, geophysics, and engineering geology and has a close working releing and the Laboratory for Applications of Remote Sensing. Closing date for application is April 1, 1961. Applicants should send a rasume, the names, addessee, and telephone numbers of litrae refers and a brief statement of rasearch interests to R. H. McCallister, Department of Geosciences, Purdue University, West Lelayetts, IN 47907.

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University of Naw Griesne/Geophysialet. Applications are invited for a permanent fac-ulty position communiting August 1991, in exploration geophysics. The Ph O. or squivalent experience

Appointee will be expected to teach graduate and undergraduats courses in geophysics and general geology, conduct a program of research, supervise theses and oversee a program in geophysics. The position will be at the assistant prolessor layer or higher depending on background. Applications era encouraged from individuals with industrial experi-

ence, ancluding recent relirees.

Applicants should send a letter outlining interest in allon, complete resume, and three letters of recommendation to Dr. Gordon Frey, Department of Earth Sciences, Lake Front, University of New Or-leans, New Orleans, LA 70122. UNO is an equal opportunity/effirmative action em-

Mostions from minority groups are specifi-

hysialst/University of South Caroll. a. The University of South Caroline enticipates a new faculty appointment in geophysics for 1991, aubjact to adequate legislative funding. We are espe-cially interested in individuals who have expertise in the fields of exploration geophysics, salamic inter-pretation, or solid earth geophysics. This would be a 9-month, tenure treck position at the assistant or as-socials professor level, beginning August 1991. Some atert-up funds are available for major equipment purchases. The individual who fills this powould join the growing geophysical component of the Geology Department, which currently emphasizes seismology, regional tectonics, and peleomagnetics, and would davelop an aggressive research program

Please send vitee and names and phone numbers of three individuals we may contect for references to Willard S. Moore, Cheirman, Search Committee for Geophysics, University of South Carolina, Columbia, SC 29208. Closing data for this announcement is

The University of South Caroline is an affirmative

Meteorologista and Hydrologists/Soudi Arabia. The School of Renewable Natural Reeources, University of Arizona, Invites applicants for seignment as faculty members to the insthute of plogy and Arid Land Studies, King Abdulaziz University, Jeddah, Saudi Arabia. One yesr, reneweble positions in meteorology and hydrology ara

 Ph.O. in melecrology with experience in under-graduato teaching and research. Curriculum in-oludes courses in melecrological instruments and methods of observation, dynamic mateorology, a noptic malecrology, physical metocrology, and of

malology.

2. M.S. In mataorology with practical experience in metaorologic operations and undergradueta viadge of WMO procedures.

 Ph.O. In a hydrotogic science or angineering with experience in undergreducte teaching and in recearch. Major emphasis will be in the areas of surface and groundwater development, water manage art gniteulaye ni bna tnemnonivne birs ne ni inam

ydrologic effects of development.

Description; The project is funded by the Baudi Arabian government through the U.S. Saudi Arabian Joint Commission on Economic Cooperation. Admir ation and logistic support is provided by the U.S. Tressure Department, while the program's implamentation is by a contract with the Consortium for international Development. The goal of the project is to undertake technical cooperation to develop educational programs for mataorology, hydrology, and land studies and anvironmental protection.
Salaries and allowances: Highly competitive with

25% overseae edjustment, housing, car and other el-Availability: Fabruary 1, 1991, or soon therashar for apring semestar; September 20, 1981, for fall semester, initial appointment of one year or more con-

Closing date: Jenuary t S, 1991 for spring aemes-ier; February t S for fell seme eter.

Application: The application should include the int-lowing: (e) a latter detailing principal qualifications and interests. (b) a curriculum vits. (c) name, addrese and telephone numbers of three references. Send to Martin M. Fogel, Oirector, CID/King Abduleziz University Project, 317A Anthropology Building, University of Arizona, Tucson, AZ 85721, Telephone (802) 926-5344/2088

Hydrogeologiat. The State University of New York at Binghamton invites applications for a permanent position in groundwater hydrology, elarting fall 1981. If is deatrable that applicant have teaching and research interests in one or more of the following: groundwater hydrotogy, modeling, flow through porous medic, and environmental hydrogeology. However, applicants with infereets in other areas will

Teaching responsibilities will include both under uato and graduate courses. The opportunity exista to intilato courses et ait levels, bui developme of one lower-tovel undergraduato course le essential ecanning electron microscope, X-ray diffractomaters, atomic absorption and transmission spectrop hotometers, and access to a lerge central computer ea well as minicomputare in department. Appointment is planned as assistant professor, but not necessarily at beginning level. Salary is negotiable, but will be at competitive academic level.

Applicante ahould submit resumé and arrange for three letters of recommandation to be sent to James E. Soroul, Cheirman, Departmant of Gaological Sciences, State University of New York at Binghamlon, Binghamkon, NY 13901. State University of New York et Singhamton is en

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Research

Placearch position in atructural geology emphastring the structural interpretation of setamic re-flection profiles, using the letost estemic process ing/modelling lechniques to interpret complex elructures. Work with ciruotural geologieto and and reauma and the names of three relerence to: Richard H. Groshang, Cities Service Compa ny, P.O. Box 3909, Tulea, OK 74102.

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Dynamic Matagrology.

Description: The Geophysical Institute and Oi-vision of Geosciences, University of Aleske, Invite applications from qualitied scientists for a full-time 12 month) Isculty position at the Assistant or Associ els Professor lavel. The successful candidate will be proposels o axismal sgancies and to work cooperative to wit ongoing research programs. He/sha will be also ex-pected to beach occasional courses in synoptic/dynamic melecrology at the up per division and gradu

ale levale.

Qualifications: Ph.O. in meleorology. Research experience in advanced analysis and diagnostic aludies of global-scale mateurological processes is essential, preferably over the full height of the almo-aphere (0-100 km). Preference will be given to appliants who can utilize their a xpertise in sync name who can unite after a specime in synophically name meteorology to synthe size the results of various ongoing research projects in mesoscals and lange-scale meteorology, cloud physics, radiation, aerenomy, and space physics into a better understanding of the large-scale meteorology of the North state state that seems Teaching several space. Pacific and poler regions. Teaching experience at the undergraduate and graduate levels is desirable. Salary: Upword to \$34,800 (Asal. Prof.) or \$43,300 (Assoc. Prof.) per year, dependent upon

qualifications and experience.

Applications: For turther information, including recent annual research report, write to Director, Geophysical Inelitute, University of Alaska, Farbanks, AX 99701. Closing date for applications is Fabruary

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Hydrogaologist. Applications are invited for e research position in hydrology, M.O. in hydrology or geology raquired, Ph.O. preferred. A minimum of 2 years experience related to water-sir heat pumps, aquifer evaluation for heat pump application, and gararat groundwater hydrology. Position involves evaluation of Montona a aquifere for heat pump use Genuelion of womana a aquitate for near pump use.

Gend resurts, copy of college transcripto, and three references to E. C. Singler, Deputy Director, Montons Bureau of Mines and Gadlogy, Montana Tech, Butte, MT 59701, by February 1, 1991.

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Goesa Dynamiciat. An academic position (tenuro-eeming track) for an ocean dynamicial is presently available in the Department of

Ocaanography, Naval Postgraduate School [NAVPGSCOL]. Prasent ar ultimate research intorest in area of naval oceanographic concern is daairebie. Such areas include; ocean circulotion modeling, especially prognostication on the ocalenic synoptic scale; surface and internal gravity wave dynamica; synoptic enalysis of oceanic date; and grephy. The candidata should be willing and able to teach a veriety of graduate courses in physical oceanography and rolated topics. The NAVPGSCOL has excellent compu ate archivel, librery, and research vessel laci The Department of Oceanography has close relations with the Fleet Numerical Oceanography Center, Naval Environmental Prediction Facility, and the Naval Esberatoriaa. The department has e faculty of litteen and a student body of 80 to 100. The overall emphasis is ocean pradic faculty and student research in coastal ocean, pole scademicend research programs are conducted in close collaboration with the Departmente of rology and Physics. Salary will be determine ations of the successful candidate. By January 1 II possible, send a curriculum viles, the names and addresses of three references, and a

Feculty Search Committee, Daperiment of Oceanogrephy, Naval Poelgreduate School, Monterey, CA 93940. Visite by top candidates will be ed soon after. A dacision will be allempted by March 1 and the position should be occupied by

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COURSES

Cell for Papera. Third International Ocean Oleposal Symposium October 12-10, 1991 Alfred C. Redfield Auditorium Woods Hole Oceanographic Institution Woods Hole, MA 02543 For abstract and manuscrip I requirements, accomtions, student frevel awards, and other inquiries

Dr. Iver W. Ouedell, Symposium Chairman Marine Sciancas Research Center State University of New York at Stony Srook Stony Brook, New York I 1794

Meetings

Space Science Perspectives

The National Air and Space Museum will sponsor a free eymposium, entitled 'Space Sciance Comee of Age: Perpectivee in the History of the Space Sciencee, on Merch 23-24, 1981, included in the symposium will be discussione of soler astronomy from speca, high-energy astronomy, luner geology, londepheric research, leunch systems technology, end a history of LANDSAT.

For additional information, contact the National Air and Space Museum In Weehington, D. C. St.

Ocean Energy Conference

Abstracte for papere to be considered for the 8th Ocean Energy Conference, sponeored by the Department of Energy, ere due Jenuary 20. The conference, scheduled for June 7-11 In Washington, D.C., has as its theme 'Ocean Energy: Meeling tha National Goals."

Papere deeling with systems orientation, industry involvement, new concapts, development plenning emphasis, and lechnology/cost ba nefft projections ere perticularly desired. Papers streesing new and significant advances or concepis in majariels, devices, or tachniques raiavant to ocaan energy are also welcoma.

Abstracts, limited to a meximum of 400 words, should be geni to Technical Commilifea Chairman, 8th Ocean Energy Conference, Marine Technology Society, Suite 412, 1730 M Street, N.W., Washington, D.C. 20036. \$

Hellenic Arc and Trench Symposium

An internetional symposium on the Hellanic arc and trench will be held et the National Technical University in Alhena, Greece, April 6-10, 1981. The formetion end evolution of the arc and tranch from fand- end sa e-based eludlee and tha relation to the lectonics of edjacent ereas will be the sym-

Comperisons with similer geofectonic structures, including the Tyrrhenian Sea and Pennonien Basin, will be made. Results of new oceanogrephic and space techniques and diecussion of deep illhospheric and esthenospharic processes esponsible for the dynamics of the sras will be emphasized.

For additional information, contact Xavier La Pinchon, Director, Geodynamics Laboratory, Acedémie de Paria, Université Pierra et Maria Curie, 4 Piece Juesieu, Tour 15, Premier Elege, 75230 Peris. 88

Senior Position in Earth Science

The Earth Sciences Olvision of the LAWRENCE BERKELEY LABORATORY has several comprehensive research programs involving the earth solances. An opening existe for a person with an astablished national reputation in a scientific discipling in Earth ogy, to essume a position of responsibility for the scientilio factorable and dissolion of major research programs such as concerned with dioactive waste storage.

Outlee will include looking the scientific initiality and direction and management of angoing projects, including the nuclear waste tectofion field involving more than 30 salantists and angineers of L9L and collaborative work with saveral goodemic and resome portains work with saveral academic and ra-tearch organizations. Additionally, the position in-volves establishment of emerging programs, expan-sion of research lactifiles and pursuit of new arcos of investigation.

The successful condidote should have extensive exorience and praven capabilities in directing and ordieving programmatic goals of camplex re-search projects involving teams of sanior solenisis and angineers. A PhO in a field of the Earth Sciances is prataired with significant applicable exparience, alary: over \$50k.

Applications will be considered no loter than April 1, 1981. Interested Individuals should lowered two resumas including safety history to: Employment Office, LAWRENCE BERKELEY LABORATORY, One Cycletron Orive, Serkeley, CA 94720. An equal opportunity



9th Caribbean Geological Conference

The ninth in a series of Caribbeen Geological Conferences, which are held every 3 or 4 years, took place in Sento Domingo, capillal of the Dominican Republic, from the 15th to 26th of August 1980. The conference, which was sponsored by the government of the Dominican Republic and the Universided Catolice Madre y Meestre, was preceded by 2 days of field tripe end was opened by President Antonio Guzmen on the evening of the 17th of August. Generous support wee provided by Alcos Exploration Co., Fsiconbridge Dominicens, and Rosario Dominicans.

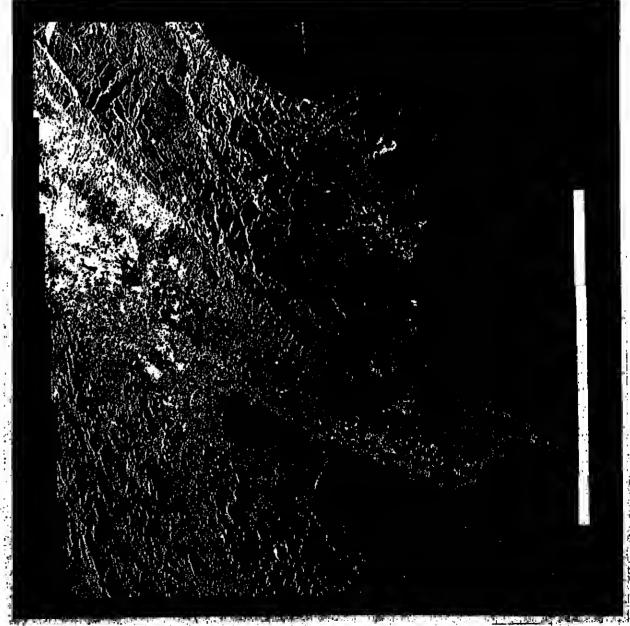
Geologiets end geophysicisis from 25 countries presented eboul 130 papers on e wide variety of topics renging from geophysics to paleontology. While the whole Cambbe an area was discussed, there was speciel ampheels on the northern Carlobean and Hispeniola, as befitted the site of the confarence. The contribution of workers from the Direction General de Mineriá wes particularly notebla.

Much of the structure, geophysics, and petrology sessions was directed toward attempting a claser understanding of the teclonic davalopment of the Carlbbeen region. Most papers concantralad on the geomatrical, geophysical, and geological constraints rather then on comprehensive models. A

panel discussion on the tectonics of the northern Ceribbean summerized the widely differing opinions on the development of thet particuler region.

There seemed to be e general consensus of opinion that the neotectonice of the northern end southern boundaries of the Cetibbeen plate ste dominated by zones of simple shear, with tocalized compression related to the eastwerd movement of the plete in relation to North end South America, Naw evidence from Jemsica end Hispeniole demonstrated thet this is a wide zone (at least 200 km), as in the southern boundary. However, the time of initiation of this deformation is still somewhet obscure.

Other then egreement that the pra-Tertiery tectonic pattern must be constrained by the rolative positions of North and South America throughout Jurassic and Cretecaous times, little consensus of opinion on the certiar development of the Caribbeen was reached. There was agreement that are syslems domineted, but there was much discussion on the age. number, relative positions, end polarity of Cretaceous island ercs. Despite a wealth of structural, petrological, and geochemical dete on Creteceous igneous and metamorphic rocks, Including new date from Jemaics and Hispaniols, the



This satellite rader image of the northeastern Dominican Republic, on the teland of Hispaniola, we's acquired by NASA's 8easal satelille, which wee built and managed by the Jet Propulsion Laboratory. The image is approximately 100 km on a side, and north is toward the upper right. The line through the image center is the result of a radar calibration pulse.

lelands of the Greater Antilles group lie on the northern boundary of the Casibbean plete. Strike allip motion along this boundary ta evident from major feuits through the Island of Hisperiola. Their trend is dominantly east-wast, and in this image they strongly outline the Citizo Valley (upper left to lower right). Left isterst movement elong the feults is suggested by offset drainage patterns, notably in the lower center of the image. Wave gut terraces in Pialetocene to recent carbonates near Cabo Frances Viejo (peninsute in the upper right) suggest that rapid upilifile also occurring along this portion of the plate boundary. (Photo supplied by T. H. Dixon, Radar Remote Sensing Team, Jet Propulsion Leboratory.)

neture of thase arcs and their relation to modern arcs are still not clear. It became apparent (to this writer at least) that much could be accomplished by systametic isotopic studias on crystalline rocks to augment recant atructural, stratigraphic, and petrological work.

The papers on aadimantology, stratigraphy, and paleontology were mainly concerned with Hispaniola. Recent work by two Fronch toams, one from the Inalitut Francals du Petrola and the other from the Universite Plarre at Marie Curlo, doscribed thick Neogena aactions in southern Hispaniofa. These were interpreted on an equivalent of the underthrust sedimonta of the Muertoe trough and as an Alpine-type itysch/molasse sequenca, raspectively. Stratigraphic and sedimentological investigations and tectonic implications for other parts of southern Hispaniols were also described. Stratigraphic, sedimentological, and paloontological studias of Tertlary rocks in northarn Hispaniola were also discussed. This included a major or asontation of results of an interdisciplinary inveatigation of classic Naogone sections by an nternational team coordinated by geologists from the Naturhistorisches Museum, Basio. Considarable controversy was ganerated by a new interpretation of rocks of the Scotland district, Barbados, as ahallow-water deposits. Another paper pointed out that Baibados was likely to have been much larther west and neoror South Amarica during the time the rocks of the Scotland district wore deposited.

The sessions on votcanology wora dominated by discussions by a University of Puorto Rico teem on the character and mechanisma of pyroclastic aruptions in the Lesser Antillea. Howavor, there wore other intorosting papers that deall with the tectonic framework of the Lasser Antilles. Geothermal investigations in Martiniquo, and the 1979 eruption of Soufriero, St. Vincont. Also of note was the description of the very recont alkalic volcanics of Hispaninia.

The oconomic goology section was one of the targest ever

at a Ceribbean conference. The enigmetic Loa Ranchos Formation in the Dominican Republic, which is the host of the western hemisphera'e largest and oldest gold mine, was widaly discussed, as was Certbbaan matattoganeals, principally in Jamaica and Venezuala. Contributors from the Dominican Republic, Jamaica, and Venezuala also presented papers on patroleum end industrial minerals.

Marina geology has always ligured prominently in the Car-Ibbean Gaological Conferences, and at this meeting, highlights included French aludies of the aubmerine geology of the Lesser Antitiaan Arc and Avaa ridge which were complemented by a report on a deep teal (Saba 8ank No. 1) that bottomed in Peleocene andesite porphyry. Papars were presantad on the paleomagnetism of both northern and southern margins of the Caribbean which confirmed the aubatantial rolations in both areas indicated by earlier studies. The general absence of magnetic anomaly signatures from the Venezuelan and Colombian basins, and the posability that structurea auch as the Hesa ascarpmenta may be old fracture zonas, ware discussed. An assessment of the magnetic anomaly field of the Yucalan basin provides a useful basia for future research, and presentation of geoid anomelies of the Caribbean represented a contribution to a rapidly advancing

The conference was concluded by a stimutating (and demanding) 4-day liald trip, which affactively presanted a cross section of the geology of the Dominican Republic.

Further Information, abstracta, and guidebooks can be oblained from 9º Confarancia Gaologia del Caribe, Apertado 2719, Sante Domtngo, Domtnicen Republic.

This moeting report was prepared by Gren Draper, who la with the Department of Physical Sciences, Florida International University, Miami, Florida.

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Geomagnetism and Paleomagnetism

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Sciences, New York Conversity, new York, 1991 Utal and H. Le Teget We present a highly simplified, some-disension-al model of the climatic system, the model Storpte to incorporate me manicus important on the time atmis of the isline cycles, namely 104-107 years. In particular, the radiction behaves of the occamentucipers, the familiation believe of the occamentucipers, the familiation of the original less state, see the occount, the sures is on the interester, between the crys-esters its on the interester, between the crys-esters (i.e. sheated only the estimosphera (upper tentia), which had not keen taken into secount ! Mantiel, which had not keen taken into sections in revious encry-halance or licensheet excludes of climate licensy-halance or licensheet excludes The nodel subbits free, sett-subtained oscil-lations of an ampitude and packed acceptable to those tound in the paleocitousic terrori of glaci-sticas, vis., offor it and noted years!, respec-tively, buth ostilations had sively teen tound in the stryler model of salitim et al. (1978, 1978). The fact that musicans alternational

tively, but northistions had diverly teen transin the arriging model of salida et al. [1978, 1978]. The fact that nonlinear, salk-mutalized socillations also obtain for the present, slightly are complex model in interacting it others all despert to the idea that unlorded oscillation can actually salat in the real climatic system itself. These qualitations are characterised by a quasist-phase ing tatesen lose estantiand plots is emperature.

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Mineralogy, Petrology, and Crystal Chemistry

4280 Mineral occurrences and deposits. HAPGARITE PSEUGGMOPPHS AFTER KYANTTE IN GLEN ESK, SCOTLANG.

Emm. Beltatele (Institute of Minera)ogy and Petrology, The National Calvarelty of Athess, Paneplettmtopolis, And Itissis, Athers (621), Greece) and C.Reteges.

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Particles and Fieldsinterplanetary Space

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free energy, the nost litery loserphilisiss mod
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may be observed are discurated,
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1970 Solar wind magnetic fields
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NCAR, Boulder, Colgrade DOUGY) and N.-Y. Xu
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Particles and Fleids ionosphere

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A statistical study of the 7020-102 (off?) - off?) and the ronducted by conleging the fata taken from the Visible Atraion Experiment (VAI) on the Atmosphere Explorer fAEL seraltices C and fouring the time particular manufacturer of the service of solar sealth segle and solar explicitly variation of solar sealth segle and solar explicitly variation are presented here. The gallett become of the sealth segle and solar septiments are a function of solar annith segle and specific the theoretical relevation has a sucreal armosphere model sod the solar spectrum as assumed by the EUV spectrometer on the Atmosphere Explorer satallifes. Purthermose, an aspected increase with solar activity also appeared in a pier of mission brightness will asked to the a pier of the EUV spectrometer. veleut solat LO.1 cm Ilux. 1. Gastiye. tee., Blue, Paper Bilai 190

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A comprehensive numerical study of ton securate double levers has been performed for both periodic sed non-periodic systems by means of one-dissection; periodic systems by means of one-dissection; to be specially set that the subset of double layers and the speciated potential jump sorms the system increase with the system length. The potential jump argors a single double leyer is sight and the separation between run consecting double leyers in typically 1000 Dabye leyth. Hamas harting one has a large re 15t of the original temperature due to the double leyer ladued acculous resimilative. The double leyer is four subset by with respect to soliton formation, (Oouble layer, lon-accounting loctability, sinctric field).

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Some Sciences Blv., 2.0. Box 999, Richland, WA.

A Comprehensive search of Sidble Aurora) Ped (199) the occurrences during the period covering colet cycle 20 (1968-1978) using data collected by shotoretare toosted at Richland, Washington (49.1%, 200.4%) has yielded a large data blace by which be examine occurrence relate the present piper has lorniblied two major modulations of this rate. It is established that the SAR are occurrence rate displays a phase lag of Approximately 2 or 3 years when compared to the tolks cycle activity as detarmined by tenspet numbers. Additionally, a rather dilling t summer implement Additionally, a rather dilling t summer implement occurrence fraquency is demonstrated insorthern hyphapherit turner). A compendium of these trust identified from the Richland observatory is presented. Current SAR art identifications (fine 1980) support these findings.

J. Grophys. Ram., Blue, hapas E041731 4 corprehensive search of Scable Aurora) Ped

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Base, Greenland in December 1879, using rn ali
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with digital lenceneds measurements, they the
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OUOSTORM INJECTIONS
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R.I. LOVYENSHEIN, N.V. Jorjio.
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The large scale sharacteristic of this precipitation reliects the adiabatic acceleration of the
process in the plasmashest and their drift moriche in the outer magnatosphate (Galperin et al.,
1978). 2) A subsuceri precipitation of ions
with energy less than 12 to 19 hav limited to the
morning assors between opproximately 001 sed 05 064 MLT. This newly observed structure is sporadit end takes piece in the boart following the
injections of plasmashest particles into the luner magnatosphare at the onset of magnatospharic
substorms. The ionospharic region allected by the
preriplession corresponds, in the agestorial plamas, no the mose is which citrés layers result
from the too drift patters (from the added affecte of convection and corotation electric listed
and From magnatic fleid gradient). It is shown
that the alectric and magnatic fields models darived by Mc tivein (1972) Iros the energy dispersion of the particles injected at 5,5 Mg ac the
substorm onner accounts for the calm sparkel and
substorm onner accounts for the calm sparkel and
substorm onner accounts for the calm sparkel and
substorm onner accounts for the calm sparkel
used to study the proce "noses" (Sulri and
hoffman, 1974; Kanradi et al., 1976) from the
rvaning addr to the morning side of the land
hoffman, 1974; Kanradi et al., 1976; how the
rvaning shor to the morning side of the inner
magnacosphere and this makes if possible to obtaio, from the injection boundary consept, a coharsot approach to the substorm injection fustutan at different local class sectors. (Subsuroral
precipiration, effect layers, substorm injection).
J. Gaophys. hee., Olue, hope 8041717

SSEL TEATHE EDITION, CONVERTION, OF CITCUISTION HEADER, SECRETION OF THE BINCED PLANETS J.G. Lubmann (Institute of Coophysics and hisnotary Shpairs, University of California, Los Angelos, CA 90021) and 6.J. Univer

50021) and 5.3. Univer

The theory of rotating ion ascephance in dipolar
magneric field memoricles is used to prodict asso
passible affects of the rings on the inner plasmaspheres of the ringed plassis Jupiter, Saturn, and
Uranus. Plassa ascephance revisits of fout types
of partiries: It believes particles with its-Uranua. Plasma aroapharos romaint of lout types of partitions: It solitable particles with trajectories that iteraced the arobase in a sther homisphere. It respend particles with trajectories that do not intersect the scobase in ather homisphere. It respend particles which reavel from the anobase to the conjugate subhen reavel from the anobase to the conjugate subhen reavel from the conjugate orobase. The anolysis carried out herein samuma a potal incompletic source. It is found that it the rings office the trapped plasma only, the cold glasma dombig at Saturn is either reduced or increased by a factor of "2 at 1.81.65, dupending so whather the ring populates or septions for trapased by a factor of "2 at 1.81.65, dupending so whather the ring populates or septions for trapase in the longapheric plasma density at France in the longapheric plasma density at France in this inner plasmasphere are primarily on halfistic trajectories which do not intersect the rings accept possibly of longitudes whath the tings are fir from the magnatic equator idue to the non-dipoint capacity companies toropament of Jupiter's field). When the yeogeties of the rings as most careatably detectioned, these contusions may have to he aftered. Nowever, it is found that if all rold glasma particles on trapped orbits err theorets and the rings are not accurately detectioned, these contusions may have to be aftered. Nowever, it is found that if all rold glasma particles on trapped orbits err theorets and the rings are not accurately detections, these contusions had long the profits learned from the figure. The summary of the summa

5503 please notion, convection, or off-

colation

Folda CAP PrickA FLOW intPT REGION

F. Prindshi, i.G. Prickani, and

F. Dyangelev, bankeb Spars Barsarch

Instituts, Dr. 2800 Lyngby, SanoAri

A region of high plasses flow valueity
centered about acon exists in the Sayaide survers oval, and is indicated by
the ORC (Girnt E Condition) plasses
recordings. The delity RIC distribution
nowness at Codeaux (77.5° invertest)
intitude) and for all Kp show virtually
no shilt in jutal like for a change of
slen of HMF 8.

I appearation of the data into Kp > 3
and Kp = Y rows no shirt is incal time
correlated with B. Yor Kp 2 I where the
locosymboric sounder at Osbarum powes
under for south oy) the cusp, for Kp >
y the sounder moves inside the polar
cap sof the SEC distribution curver
show a small E dependent shift in the
same direction'ss the shift in the cap
twal polar cap of large electric yield
and high Ylow relocity.

The suggests that the plasses flow lo
sed agastoryers of the broat region is
infependent of the polarity of Ap.
J. Osaphys. Sam., cloc. Pryor SGALIOI

J. Osaphys. Sam., cloc. Pryor SGALIOI

Particles and Fields-Magnetosphere

5720 Intermetions between solar wind and segmetoaphere
THE PROPAGATION OF USETSHAN PROTOIS SETWEN THE
SESTH'S BOW ENOCE AND 1948-1
T.E. Senderson (Spees Science Ospertment of SEA,
SHEC. Moordwijk, The Netherlands I R. Seinhard

T.E. Sandarson (Space Science Usperlant of the Santa Santa, Noordew ja, The Setheriusdai E. Seinhard and h.-P. Menzel
We present a detailed melysis of a arries of 3
we present a detailed melysis of a arries of 3
notassive upstress proton svents chastword within access hour line period of it detaber 1976. The obervations were made by the low-energy proton instrateset on ingE-E which is designed to esture
three-disencional anisotropies in the energy
trang 35-1600 heV. We have assented this particurang 35-1600 heV. We have assented this particular series of svents observed at the posttion of
lattest proton events observed at the posttion of
lattest proton events observed at the posttion of
lista-y, more than 200 R. upstream iron the Earthleou shoch, because the Empression resident that the resounded of the selection of the propagation of upstream protons wars amencelly olear. We
swadne in detail the letenatry profiles and proparties of the assentrepies of particular interpretens of the assentrepies of particular interpretens of the selections of the graduary
resola that upstream protons propagate in thesis
or slate from the Earth's how shock out to 1572-3.

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THE MOVIAB REMOTEDRATE AND ITS CUmpker AMERT
THE MOVIAB REMOTEDRATE AND ITS CUmpker AMERT
K. V. Bethanson (8458-700ddard Spage 71 tight ComboK. V. Bethanson (1998)
The Springs and K. Y. Bender Standing of the structural
hard extended pur tander standing of the structural

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and temporal engracteristics of Jupitor's magnetic and temporal characteristics of Jupiter's magnetic tail. The negative of the regments field in the lobes of the left is found to decrementation of the left is found to decrement of the power less exposent of -t.7 lound for the with the power less exposent of -t.7 lound for the rate of decrease along the flonest to outhouse trajectors. Loyager observations of magnetic trajectors. Atyager observations of magnatic field acropaent variations with Jovicantrie distance in the tail do not support the uniform ratini plasma out-flow rotal derived from Pioneer data. Yoyager 2 has shown that the attenuthal ourrant shout which surrounds Jupiler in the timer and middle magnelogapher extends "lollward" its the anti-Sun direction to a distance of all lenst NOP. the anti-Sun direction) to a distance of all lenst 100 P_J. In the tail this current sheet consists of a plasma steet and subsided "neutral" theretains to the region of the toil where the sheet is observed, the variation of the magnetic titeld on oretuit of the sheet attroture and its 10-hr periodic notion is the dominant variation seem. Studies of both the large-sende configuration of the oursest sheet viewed as a surface and of the internal structure of the sheet and its crientation indicate that till at distances 3,30 P_J in the tail the sheet to oriented within 100 to the Joyian counterly lane, rose their a result. tail the sheet is oriented within 100 of the Jovian equatorial plane, nost libely as a result of the solar wind interaction with the Jovian nagnetosphere; (2) the surface cowes north and south within an amplitude of several 1, with respect to that planes and (1) at large distances this solion to primarily due to a racking of the current thest about the Jupiter-Sun lise. I nathematical codel that takes the total geometry into spoount provides a simpler description of sheet rotion in the deep test than codels based on start symmetry. The planes there is not to the test to estimated to have an extrage thickness (5 h., [Magnetotall, current sheet, nagnetamphere, Jupiter].

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5742 Magnetosheath
JBFITER'S MAGNETOLAUSE, BCW SHOCK thu to-MOUN
KOULLITED MAGNETOSHEITH: 1071CERS 1 eee 2
0. P. Lepplag llaborator; for Extratorisatrial
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Greenbelt, Re 2071t1 t. F. Burlege and L. W.

injetom, sinjeduciero Spece Filght Center, Greshelt, no 2071t; t. F. Burlegs and L. W. Hein State and L. W. Hein State and L. W. This aumori report discusaes Juptter's megoptopeuse, box shock and nagnetoshesth, based on line soit magnetic listed data from the folgage I and 2 encounters. Expitait nucleis of the damnelds megnetopeuse and bow shock in Jupiter's orbital plane explot an astyrmatric parabols and hyperbole, respectively, and satisfy average boundary prostling pattons, inhound and outbound; these models are determined separately for the two encounters. Average nightopause accusit, astisted by dictors verlance analysas of the field, generally satisfy the codebysrolois to within a faw degree, ascept for the togger? outbound crossings, easy phenomenon has been discovered in Jupiter's magnetoshesth. It is santlested as 15 orl 10 hour quasi-period to modulation of the direction of the magnetic field in the outbound semestoshesth, predominantly in the northwerd full and southward fill directions. Il was seen to cour during both servisters and appears cost system in Vergeer 2 authound observations, the durestons of the 8 for transitions range iron tent of minutes to "hours. These transitions cour in a plane paratel to the local mydel magnetopausa location. These alignatures may be due to respectively. the magnotospheric plasma disk. Geophyr. tea, Latt., fapar folital

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MYODOIMORIETIC MAYE OBSENVATIONS IN THE VICENTY
OF A MACHIOSPRITIC LLASM DESSITY CRADIA

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S.J., UPPra and A. Molfe
Data from the Boll Labracerties deferonce or

F. J., U797-1 and A. Noifer
Pata from the boil Labratutium magnetories stations in the Northeth heotophase are ansived Juring a tepotial general of the 15EF-1 end -1-2 apacotes it through the mane local time sector is the ground-based attained. The ground-based distindicent that doolnamb thirto-spantia were itaquenties becats higher with decreasing tedical distance identeesing indicated by the data tecorded slong the satellite track. Further, a wave resumence identified in the ground-bated data occutted as a shorp density guadient is the tangentaphits places as rapercad from this procedure is particle experiences. The theoretical conditions for existence of this tatoesace are consistent with the satellite resumersame of significant fluxes of f · 1 lons as tonet buttons to the magnetosphere pitace population at this title. (Magnetosphere pitace population at this title. (Magnetosphere pitace population at this title.)

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DESCRIPTO WITH 1858-1

1. L. Barvite, (Department of Thysics, The
Daiversity of Alabama to Sunsaville, Buctaville,
Alabama 55899) C. S. Bacghar, C. B. Chappell,
S. G. Shellsy and O. T. Toung

(Descriptions of panesha tyaak lium many 90°
yitch angle) distributions of low-energy
(5 ADDAY) ions are reported. Pancake distributions occur pitam in N° rad Re° simultanesealy while O' Singas are either undetectable
or field-aligned. These N° and He° panesha

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Honor Your Colleagues The Waiter H. Bucher Medai Committee

This committee, chaired by Gryan L. Isacks, is seeking nominations for this award, which is given in odd-numbered years, for original contributions to the basic knowledge of

te earth's crusi Lelious of normingtion and supporting materials should be seni directly to feacks at the Department of Geological Sci-onces, Cornoll University, lihaca. New York (4850 The clishon and acceptance for the 1979 Buchet Medalis Edward Irving, were published in the August t4, 1979, issue of Eos. Previous recipients were:

1988 J Tuzo Wison 1969 Jemes Oduty 1970 Devid T. Gagge 1971 Robert S. Dietz 1972 William Jason Morgan 1974 Maurica Ewing 1975 Lynn Sykas 1977 Buico C Hae zen

DEADLINE FOR HOMINATIONS IS JANUARY 18, 1981

distributions typically display characteristic annualism of the order of 10eV and are frequently mixed with higher density, colder (AT 5 7eV), lectespic, quant-harveillan components. Thus appear olses whehis the outer regions of the pleasurphore, sed seem to occur most frequently so the dayside and meer the magnetic agments. magnetic equator. 1. George. Roo., Olus, Paper 80A1760

StiO Shore-pariod (less than I day) vertations of magnetic Hald artificity veptations in pit pulsetions AT 100

LATITUDE P.B. Sutcille thagneric Observatory of the CAIR, f.u. Son 12, Mercanag 7300, Louth Africal A study of the temporal variations in the horizontal study of the temporal variations in the horizontal study all petcity of P12 pulsations poratded at a low latitude station reveals both noc-turnol and annual variations. Killeticity doreases fro monitive to nemality through the night; the greatest decrease occurs during her verber and the emailest during May. The verter tions orhibit trends similar to those in plasmas pheric electron density and total immesphetic clariton content. (Pr? pulsations, polarization, ullipilcite, plasmamphores. Reuphys, Ess. Lett., Paper SUL[384

5770 Short-period tless than I day) votistious of magnetic Hald SHCTRAL CHARCTERISTICT OF MAINETIC 717 hullstigs in the Curural Begun ASD Lover

M. Russbira Waktoba Magnetic Observatory, 51%, Seltoka, Tasato-machi, filhati-gum, iberati 315-01 Jitaki and T. Belto. 315-01 JIRAN and T. Balto.
The spettral characteristics of cognetic P42 pulsations are studied using dita obtained agustiangously over a wide intirodical range too the according region (i.e., b) through low-intitudes tight, the P14 perfod, which is remembly observed over the wide latitudinal range, shows a close relation to the putition of the assertated suroral breakup. It becomes shorter flongers when the success breaker starte at lower highert irritates. The olegrentiates tenuite substantires well the corplines sacility tion model which suggests that Il's is camed by the total onal hydromagnetic and listing of the geomagnetic field lims anthored on the Autoral J. Geophyt. Pes., Blue, faper SOAIS9t

Physical Properties of Rocks

bild Electitity, Frantuis, and thow

EXPERIMENTAL BIGH TEMPLEATURE AND RICH PRISTURE

IAULTS

Giscore i, Shelton (Department of Geological

Eclance, Stown Dalwarell, Providents, all 07912)

Jan Yallis and Terry tuills

Georganion experiments on Maje abbits tork

have produced faults at 1 to 15 kb coulding

pressure and 700° co Hill'C, when hylrolytic

weakeding is suppressed by athem hylrolytic

weakeding is suppressed by athem hylrolytic

weakeding is suppressed. The faults are

characterized by: 1) an engle of shout 35° ro

Oi, 21 vary little gouge, and y) several per
crnt fermantal serale before islaure. Texpera
turs dependent friceton is believed to allow

frictionat attding and faulting an arrasses

below those predicted by the Coulomb failure

criterice, Sut above those of hydrolytically criterico, Sut above those of hydrotytically wantened crystal plante liow. High roufints pressure, low frincipm and reduced tentile street concentrations as sliow the Yest to Propries is a cheer rather than a tensilioner. (fruits, water, high pressure). crack. (frults, water, high proom Geoghes, Res. Levr., Yapar Bollaid

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EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

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JANUARY 6, 19B1

Planetology

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I. M. Mierer Intervalent Space Flight Center.
Orestarit, Mr. No.771 B. Centerly, J. Mirregile.
P. Clerk, B. Fresth and P. Gleresth
Tengeretures of through thind, durined from
Dyager 1815 date over the Great Fed Spat and its
ensirens, are presented. The etholybers after the
GSJ is characterized by a tropopases which is raid
releties to be endought on an appearant to
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inversifies with height above 100 on through the
inversifies legites a Cerrence the CSJ itself, but
entated little emission free the CSJ itself, but
entated intil emission free the CSJ itself, but
entated entation in a ring about it, in agreement
with resent group-flatted results. The cohester of
the tropopases of 5.e temperatures can be
accusiatedly interpreted as resulting trop a
coloration which rises within the GSJ self
authories in the area should be the presenters in not so
attraget forward. Expectance augustion that they
may be a configuration of the present augustion that they
may be a configuration of the present results for earlous
the group salet-west symmetry in the stratoexpect the group of the GSS are studied, and
the possibility she belief beat release drives
thereast inter, seld from the nonlinearities
thereast in the garmaterisation of selection suggest that, solds from the nonlineration thereant in the garanteriestion of small-side solds cristotion, the large-erals dramakes of the GBS are firest, as distinct from those of a systome, which ere markedly er Geopt.e. Tes., Green, Pages BGc1781

6510 Stadepharms of Planets
THEOMAL STRUCTURE AND LITHRESS OF THE JUNGSE AND STRUCTURE AND PRAYINGS
D. Conreth 18454/Godiani spece Flight Conter, Oceanbell, No. 2011) F. M. Finner, J. Pierseile, P. Glesenk and C. Kott

Greabell, M. 2011) P. M. Planer, J. Pirreglia, P. Glersch and J. Hatt.
Lovestigning of the thornal struture shows sainsted cloud features in the Julian structure, sathing and of Voyager 1817 data, seconds afrom smaller lines among a breat sampe of features which differ a sabilerably it wisned appearance. The absorphers above antiry-hade features, thriuding the saper shore antiry-hade features, thriuding the saper which owing the Creat Ped first, and a some, are rold retails to the immediate surfoundings in the upper tropespeers and tryopasse. These results are consistent with upwailing and divergence in the part of the stance-planer. These results are consistent with upwailing and divergence in their secretaries, we found to be warr relative to their secretaries when the states indicates a decay of the worticity with height in the upper troposphere wall results of the charact desportance from the absorped temperature perturbations larly was upper limit of vertical along times hear the trupopasse of 20 years. Temperature in the upper strateghers above the antisystems in the upper strateghers above the antisystems in the upper strateghers above the antisystems features who considerable separation, but in most cases are found to be retailively ware. The second line of a thickness finding for this passes in the upper strateghers above the string of the passes in the upper strateghers above the string of the passes in the upper description of the features who considerable separation. Coupling laborier species to exist

6510 Atmospheres of pienese LARCE-SCALE COPULAT SYSTEM IN THE DAYSIDE VEHUS 1000978882 3.6. lubhann linetitete of Gacyhyelco erd Piene-tery Physics, University of Californin, Los Ageles, CA 90024 USAN S.C. Siphic and L.H.

Ageles, CA 900% USAN S.C. siphic and L.M. Sears

The Occaelcost observerion of large ecale horisonal magnetic lisids within the dayside lean-sphere of Vrees by the tingste bagestowers on the Pioneer Years Ophics seggets the presente of large scale cureant systems. Using the mansurd attiteds profiles at the engager it field end the electron deality and temperature, together eith the psevinusly reported enuted temperature attitudes profiles in the lound that the lossity and respontation, it is lound that the lossity and respontation, it is lound that the lossit loungapers can be described at these times by a simple so lei which tranks the unabserved sistents field es a parameter. When the model is appropriate, the altitude profiles of the tem end electron velocities and the currents along the excitite trajectory ran be inferred. These results alectidate the configurations and sources of the tempaperies current systems which produce the observed large scale anguests fields, sat is perticular illustrate the effect of ion-peutral roughing in the determination of the current system er low stitledse.

J. Gandhar, Sea. Sinc. Franc. 2014(4) Geophye. Pro., Blue, Feyer SOA1628

6310 Atcrepherse of planets
OSCILAYIONS AND VELOCETY STRUCTURE OF A LONGLIVED CTCLORIC SEO:
A. Battes, D. Ventert, A. Ingerecii, S. Danielson |
[California testitate of techniczy, Ole Edino of |
Goolegics | and Planetary Sciences, Peesdees, Celifornia 9123]

Dart brown cyclonic spots | "harges" | at it a |
Swers studied using Voyager | and | langue of |
hylics. Mayis sequences were and to study the optic behavior over intervels of 30 days and |
longer. These words rescaled that the langth and eidith eary by 99% with a pushod of about 15 days, while the state tension appearies tely tonstate. The horizontal valentity field use invegtigated for an intervel all about one day. Plow around the largest burge (festere 8) occurs an oring caserest. The vorticity lelevared is shout two and case-hell time that of the sublect rysionic sunal sirculation, and about one-helf the price of the local piscettery vorticity. Leggly and width verteilone superst on he associated with a bea-tern borisontal disagners field, il the ast listices are a natural mode of the bystem, the 11-day petiod elli ptovide an important datum for testing models of atchio placed vottires. [Houle, outilestine, vorticity, [J. Caphys. Res., Green, Paper 8001753]

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STRUCTURE OF THE LUMAN CRUST SE SIGNLAND SITE STRUCTURE OF THE LOUIS CRUST ST SIGHLAND SITE APOLIO STATION 15

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ANALE, Codes (hobil Emearch and Bevelopment Carp., F.O. Box 900, Delines, TX 15221; Ausen B. Delets and H. Eafl Johnson TX 15221; Ausen B. Delets and G. To catend the sality also of still clait impact late. To extend this knowledge we have aned date from material least prices of still clait impact and material least prices are serviced to the lors of paging and still plan assuad by reflections of trusted letteraces and connected in reviews as the services as the still and services are serviced to the lors of paging and the services are serviced to the lors of paging and the services are serviced to the services as the services are services as the services liever pertiris notion expected for the onset of these body week arrivals in the emittered rode of lutar estanganes. The results of this work testesteely indicate that the highless dike at station is has a 75 in thich creat with an intermediate 20 km interface in Oceanse Procelierum, a curst region. Since the 20 km apper creat appears to waist at both highless and mars eitee, it probably Sous out represent a sare headt layer but rather a ours general fanture of the creat. Create thickness may paratally control signature by Jamesteey. by Incetocy. Georings. Ros. Lett., Paper dDL1582

Selsmology

6970 SERVICTURE OF the Crust and Upper Maries CONSTRAINTS ON THE SEISMIC WAVE VELECITY STRUCTURE SERVANT THE TIBETAM PLAIRAIS AND THEIR TECTORIC LIGHTCHYPONS W. P. Chen | Haseschussta institute of Technology

77 Measuchusetta Nesus. Cambridge, My 07118)
We combine observations of group and phase selective fispersion of Explicity waves, of the wave form of a Long period? Phases of F pod 8 valuation of a Long period? Phases of F pod 8 valuation to the wave serious of a Long period? Phases of F pod 8 valuation to place bounds on the selection wave versions to place bounds on the selection wave versions. From services ware measurements allowed services. From services ware measurements allowed. calties true surveyees fatraction possiles Hing sarthquake, and of telessismic a-p treval time sasiduals to place bounds on the selecte wave velocity structure of the crust cal apper sentts under the tibeth. From seriets wave possurements along the Tibeth Prom seriets wave possurements along the Tibeth rowards thickness can be true 55 kg to sa lar, with courseponding oppersont ment's shear wave velocities of shout 4.8 km/s to 4.9 km/s, respectively. The P and S estocities ware determined to be 8.1270, s km/s and 3.830.8 km/s sespectively using travel time data at these from earth-quakes in and on the annyine of Tibeth. Combining vesuits, the crustet thickness is cost likely to be between 65-80 h with an asweage shear wave valocity in the opper cruct less than 1.5 km/s. A synthagis of one P, wave form does not provide an additional essatishing to the westority structure but 1s compatible with the range of models given shows. In contessed to observe tions obtained for eight authorates in the Minalays, nessurements of both talesgiamics 2 km/s for ease seriest times for nine serthquakes in the Minalays, nessurements of both talesgiamics 2 km/s for ease seriest times for nine serthquakes within vibet show unusually lever intervals between P and 8 compared with the 3st-frays-Buller Tables. This the P and 8 valocities heart for experiment of the seriests well of the the contest in the sancte to a greet depth beneath Tibet. From the department of the seriests well of the plantfars in the seriests well of the seriests of closes to 100°C. Sooks a tampers the compatible with being 250-300° higher than beneath the plantforms, i.e. 750°C il the tampersture beneath the plantforms is the bose of the conduction catevities the subject of the seriest of the compatible with being colors to 500°C. Sooks a tampersture could ranch or annead beneath heat conduction catevity tould be appliable by the seriest flux of about 0.9 km/s at the bese of the crust. If the distribution of redicated by a martis heat flux of about 0.9 km/s at the

Circulation in the Coastal Ocean, Part 1

G. T. Csanady

Woods Hole Oceanographic Institution Woods Hole, Messachusetts

introduction

Although the typical depth of oceanic basins le 5 km. e eignificant frection of the earth's surface te covered by a much shallower sheet of weter (only about 100 m in depth). In addition to many email lakes and lagoone, this includes extensive ereas, with horizontal dimensions of 100 km and mora, such as the Great Lakas, continental ahetves, or targe guils such se the Guil of Maine or the North Sea. These relelively large bodies of water behave dynamically in en 'ocean-Ic' menner, in the eense thet motions in them ere strongly affected by the earth's rotetion. They will be teken to consiltule the 'coestel oceen,' e term thet covers enclosed end semiendosad basine, ee well ae open seas auch as the broad and flet continental shelves of the 'Atlantic' type or the narrow and steep shelvee of the 'Pecific' type.

The dominent observable motions in the coastel ocean ere rotary currente, which ere eseocleted with lides over continental shelves and with inertiel oeciliations in stratilled, anclosed seas. Such molions, in what one might cell a pure torm, are charecterized by the rotation of the current vector through 360° in a period not very different from the earth's rotation rate, and they illustrate the dynamical importance of rotation. Water perticle motions during a full tidel or inertial cycle are elong e closed ellipse of e typically longer exis length of a few kilometere, there being no net dieplecement in en idealized pure tidel or tharfiel oscillation. Of course, in reality there is always some residuel motion, which adde up cycle efter cycle and produces fluid particle displacements over the long er term that ere much tergar than the diemeter of the Ildel or Inertial ellipse. Figure 1 Illustrelas oscilletory end residue) motion by meane of e progressive vactor diegram of velocities observed at a fixed point in the Great Lakes. Although this le not the sema as tha path of a given perticle of water that passas through the instrument, over a tew oscilleting cycles the correspondence is close enough for illustrelive purposee.

The problem of 'circulation' is to describe and understand the pettern of the residuel or longer-term water perficle displecements. The dietribulion of importent water properties, e.g., lemparatura, salinity, end the concentration of heavy melals or nutriants, and the transport of these properties, or of file-forms incepable of locomotion, depands critically on

This paper is the lirst of three parts. Parts 2 and 3 will be published in subsequent lesues of Eos.



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Cover. Photograph shows the sawn Interior of a 7.9-kg mateorite Elephant Moraina 79001, recovered by the U.S. Antarctic expedition In 1978-79 and now part of the Antarctic meteorile collection being curaled at the NASA-Johnson Space Cantar in Houston, Taxas. The melecrite is appearently related to the shargottites, a rare group of achondrile metacritae comprising Shargotty, which felt in India in 1865; Zagami, which tall in Nigaria in 1962; and Alian Hilla 77005, recovered from the Antercilc in 1977-76. The relatively young ages of these three baselite metaorites, less than 1.4 billion years, raise hisresting quasilio metaorits, less than 1.4 billion years, resolvents and, it so, whather that igneous scillyty look place on amail bodies, such as the asteroids, where plausible heat sources are a problem. problem, or on one of the inner planets where volcanism may have persisted throughout most of eolar history. Cooperative studies by several investigators will begin abortly on this new a ample EETA 79001, which more closely resembles the shergottles than any oth meleorile group. It ta also unique amding known extretemestrial mate fals in showing an apparently undisturbed igneous contact betwarn the pyroxene-rich main mean, to the left of the photograph, and the photograph, and the wife.

within the sample are patches and veinlets of dark glass.

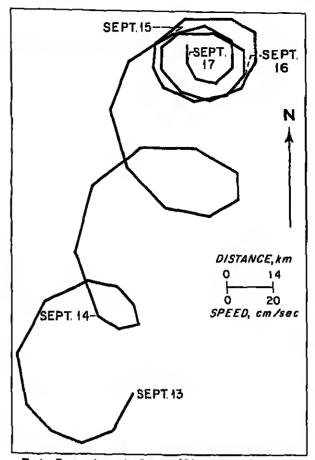


Fig. 1. Progressive vector diagram of 2-hour sverage currents obaarvad at a lixad mooring in dasp water in Lake Michigan. Motion consists of nearly circular inertial oscillation and northeastword rasidual drilt. (From Verber | 1986).)

the pattern of droulation, but not vary much on the oscillatory weter motions, et leeat not in e direct wey (indirect effects include, for example, the turbulence and mixing produced by

The study of circulation end mixing processes in the coesiel ocaen hes received considerable impetus trom tha racent awarenese of pollution problems which heve been growing since the eerly 1960's. In some erees of the coastel ocean, major experimental studies were undertaken which led to an impressive accumulation of observed tacts and in some casas to a comparebla increase in understanding. What we learned about the coestal ocean during the lest 20 years certainly dwarfs previous knowledge end understending.

It is not apparent that this greatly increesed body of knowladge has so far had any significant effect on public debates of pottution problams and remadles. Parhaps those of us who heve been involved in the great expension of coastal ocean research should make greater efforts to make our voices haard. The present review le ona attempt in this direction. Bacausa our work on coastal circulation was clearly made possible by society's environmental concarns, it is appropriat a to slart with a discussion of this context.

The Coastal Ocean and Contemporary Civilization

Men have used the coastal ocaan as a highway of commerce for millenia. The Mediarrenean civilizations of the Greco-Roman world or of the Middle Ages would have been impossible without busy coastal traffic. Undoubtedly, some knowledge of coastal ocaan behavior was required for eate commercial navigation. It is probably fair to say that the prosparity of many city-states on the chores of the Mediterranean. and later of the Baltic and the North asas, was built on the seetaring compatence of the capteins who commanded thair merchent navies. Similarly, navel supremacy was critically dependent on an understanding of the esa, especially the coeelal oceen. A good case can be made that the triumph of the British and Dutch neval lorcee over the Armada of the Duke of Medina Sidonle was not only due to superior technology but also to better acquaintance with the treacherous etretch of coastal oceen separeling the British Isles from Eu-

Af the present time, vesaele of the limited size and andurance available to ancient mariners are still in plentiful use. although mostly for recreation. The 'aaerch and rescue' mission of the Coast Guard protects this armada of small vaeeels, in support of which predictive models have been devaioped for the drift of disabled vessels. One of the key problams in euch models is to predict eurface currente in the : coeetal ocean eccurately enough to minimize time spent in 'aearch' in order to proceed epeedily with 'rescue."

Another use of the ass, the roots of which are lost in antiquity, le fishing, an industry that has traditionally eustained populations of teland nations such as iceland or Japan. Today, it is well-known that the coastal ocean is the main Today, it is well-known that the coastal ocean le the main source of seafood, prime producing regione being, for example the Grend Sarks of Newtoundland or regions of 'coastal upwelling,' such as the coastal ocean of Paru. Fiehling reseals: if e often observed to congregate near the outer boundary of the continental shelf, usually taken to be the 100m in 200m is obtain. Why should fishing be so good at the logs of the continental shelf? The answer no doubt decending circulation and mixing to this region, which can depends on circulation and mixing in this region, which controls the specify of nutrients to low-level life-forms. The economic importance today of the Grand Banks fishing region. and of similer highly productive regione of the coastal ocean. needs no further elaboration.

eeds no turtner sisporetion. In contemporary civilization, the leave of conflicting uses of the sea hae arisen with some force. One of the contentious subjects is the dumping of waste in the ocean. From one point of view, the ocean is a vast blochemical factory which can recycle a variety of wastes produced by modern men into

32 1 2.0

'nonweatee,' i.e., compounde naturally precent in the environment in eoma concentration. When discussing the disposal of euch wastes, if te natural to speak of the 'assimilative cepacity of the ocean and to exploit it when ocean diaposal je more economical than other methode. Two potential probtems ere immediately apparent: one, wastes may have undestrable effecte before esalmiletion, e.g. while their concentration le much above normal beckground concentrellon; Iwo, some wastee era men-made and mey not decompose into neturelly present eubstancee for very long perioda, if evar. Examplea of euch substencea that are allen to the naturet environment are plulonium or PCB'a, which turn out to be toxic to verious life forms. On account of the loxicity of these meteriels, their dumping into the oceen clearly conflicte with the treditional use of the asa as a source of tood.

Today, there is a bewildering variety of weete disposal or. et any rete, 'rejection' operatione that heve some antiaeathetic or polluting influence on the coasiel ocaan. The concentrated residue of New York City's sawage (sawage sludge) her been berged to an offehore site for the past 50 years or eo. This site is relatively close to the New Jersey end Long Island coestlines, where the weter is only about 30 m deep. In spile of the huge volumes of sludge dumped at this ahallow eite over the years, edverse effects could only be documented in the immediate neighborhood of this dump site. Even hera, they were surprisingly mild. Cleerly, the 'essimilalive capacity for studge of this part of the coastel oceen is impressive. Most municipal sewege, however, aniers the oceen closar to shore, et the end of outlell pipes, and the local effects ere not etweya antirely ecceptable. Some industrial wastes that are otherwise difficult to dispose of are dumped at deepwaler eilas (106 miles from New York and off Prierto Rico, for example) that are still quite close to the coastal ocaan. Elactric powor ganeration involvee the rejoction of lerge quantities of heat, released in many places into the coestel ocean. The abarch for end extraction of petroteum over the continentel shelf lends to the reloase of drilling muds end to some oil spitts, atthough the latter are dwarfed by spills from large tankers.

Contlict in the use of the sea-and of the ntmosphere, lithosphere, end other parts of the hydrosphare-has brought us the reguletory agency: in the United States, the Environmental Protection Agency, the Nuclear Regulatory Commission, and other bodies with similar powers. The task of these agencies is to resolve the conflict over uses to what ono would hope is the greatest good for the greatest number of people. Not even the best triends of these agencias would claim that their decisions have in fact always been this wise One important cause of counterproductive ragulation is ignorance; when the consequences of a given waste disposal operation are uncertain, there is a landency to disallow such an operation, even when the available atternative waste disposal strotagles have fairly serious adverse consequences A case in point is the near-prohibition of warm-weter discharge into the coastel ocean in such cold regions as the Great Lakes or the Gulf of Maine. Several power companies have been forced by such rules into the construction of huge cooling-tower clusters. These are unsightly, their high cost contributes to the rising price of efactricity, and most imporlantly, they cause local climata modification of a most undestrable kind, increased in cidence of tog. clouds, icing of roads, which with statistical certainty kill so meny axtra motorists each year, it is difficult to imagine a scenario under which the simplest straight-through discharge of cooling water directly into the coastel oceen, even without any attempt to mitigate the effects of the heated water, would have comparable consequences.

The greatest public attantion has been tocused on nuclear power, opposition to which has lekan on religious overtones. Given the emotionalism aurrounding this issue and our sensation-seeking media, thie is one case where one sympathizes with the regulators in their attempts to base their decisions on reeson. One alternetive to a speedy development of nuclear power, including a eystem of breeder reactors, is continued relience on oil imports from countries that are politicatly unstable. Other elternatives are no more dasirable. Aa far as the coastal oceanie concerned, adverse effacts of nuclear power are due to waste has I rejection, which tekes place et e slighly higher rale than in fosell-fuel-fired plants; to the continued release of radionuclides at a low rate; and to the risk of catesirophic fellure, which would be eccompanied by a much greater dose of radioactive release Into the coastal ocean. The extent to which these corolleries of nuclear power generation effect marins life depends on circulation end mixing in the ocean, especially in the coastal ocean where all releases are concentrated. In the case of the proposed offshore nuclear cower clania, the mainlend would be protected by a 4.5. km-wide moet, in which the trensport end diffusion of auspended and dissolved materials would be of epociet interest.

Retional requistory decisions that concern conflicting uses of the coastal ocean aboutd be besed on quantitative modele

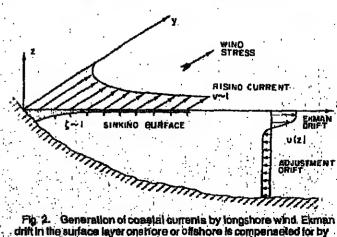


Fig. 2. Generation of coastal currents by longshore wind. Ekman drift in the surface layer on shore or offshore is compensated for by mollons accompanying adjustment to geostrophic squilibrium. The fiuld below the Ekman layer is accelerated in the longishore direction. by the Cortolla force of (cross-shore) adjustment drift.

Ihal predict some sgreed meesure of nulsance or hezard essociated with a given weste disposel or similar operation. The development of euch models is a task of engineering science, which is outside the scope of the present srticle. These models, however, require quantitative inputs from vertous sciences, including the physical oceanography of the coastal ocean. In perticular, e solid body of knowledge of circufation end mixing processes which is widely accepted by the scientific community is required. Other wise, extrevogent cloims cannot be easily refuled, and reason becomes overshadowed by doomsday philosophy. On a retional level, the knowledge of coastal ocean physics is a prerequisite for e comparis on of the consequences of oceants disposel with the consequences of ellernative disposal etrelegies.

Wind-Driven Transient Currents

The prime driving force of circulation in the coaatal ocean lathe wind. This is not always obvious in tidal waters, but people living along the shores of the Great Lakes, for examplo, where fides are predically nonexisfent, ore well eware that wind ection on coastel waters rapidly generatee flow predominently porellol to the coast. The coast prevents perpondicular movement, but longshore motion is unhindered and the longshore component of the wind is particularly affective in generaling longshore currents end correspondingly long particlo dispfecements.

One of the fruits of recent field studios and associated theoretical work has been on undersfending of the structure and dynamics of such wind-driven ne arshore currents. Earfler ideas came meinly from ploneoring theoretical studies, euch se those of *Ekman* [1905], which wore based on verious ideolized on the serious individual serious indiv

fnertial offects may be simply understood with eld at simple medals in which boltom friction ts supposed absont and a longshoro wind strees is suddenly imposed at the surface. Any porsistent longshore motion that arises must somohow adjust to geostrophic equitibrium, I.o., the Cortolis force assoclaied with longshoro motion must eventually be balanced by an appropriate pressure field. Rossby [1938] lirst discussed such problems of 'geostrophic adjustment,' and Charnoy [1955] extended Rossby's work to coastal current generation in a two-tayer ocean of consient depth. In Charney's quasigeostrophic model, the accelerating longshore current is poslulated to adjust continually to geostrophic equilibrium. In reality, this may be expected to be true for periods of order for and longer (/ = Coriolls parameter). More complete calculations for simple closed basin or coastal zone models confrom thet the response of a modest size sea ($t \sim \text{constant}$) to suddon wind stross can be regarded as a superposition of a quasigeostrophic (developing) coastel current end various

The dynamical principles involved in quasigeestrophic longshore current generation that are elucidated by these theoretical studies are Illustrated in Figures 2 end 3. The surface level perturbation and the long shore velocity increase hand-in-hand, maintaining geostrophic balance. In the long-shore direction, the wind-stress impulse equals the depth-integrated momentum of the water column, ee long as bottom triclion is negligible.

The simple momentum balence in the longshore direction belween the applied lorce and the increase of momentum in the water column can hold in the coastal zone because the depth-integrated Coriolis force associated with cross-shore flow vanishes. This is a direct consequence of the cosslet constraint, i.e., the condition that no water is trensported in a direction perpendicular to the coast. The coastel constreint applies strictly et the coast, and to a high degree of spproximation within some distance from the coast. The length of that distance is an important quantil stive deturn of each coastel ocean, characterizing its dynamical response and depending to e large extent on the depth distribution es a tunction of distence from shore. Ganerally, the coastol constraint holds a longer dislance from shore over e flat shell than over e sleep shelf, but a number of other tectors enter this question. In any ovent, the coastsl constraint is often found to apply in water of order 100 m in depth.

In such relativaly deep water, tha force of the wind diractly affects only a thin layer at the surface, the rest of the weter column responds indirectly, through pressure forces generated by the displacement of whiter masses. Within the eurfince shear layer subject to direct wind action, turbutonce governs the distribution of wind imparted momentum, while the Coriolis force nots as an important modifier of the tiow. A fur-

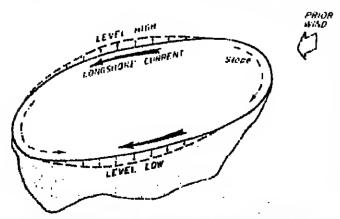


Fig. 3. System of coastal currents generated in e basin of simple shape by uniform wind. Geostrophic balance requires a rise of sea lovel along one coast parallel to the wind, a fall along the opposite

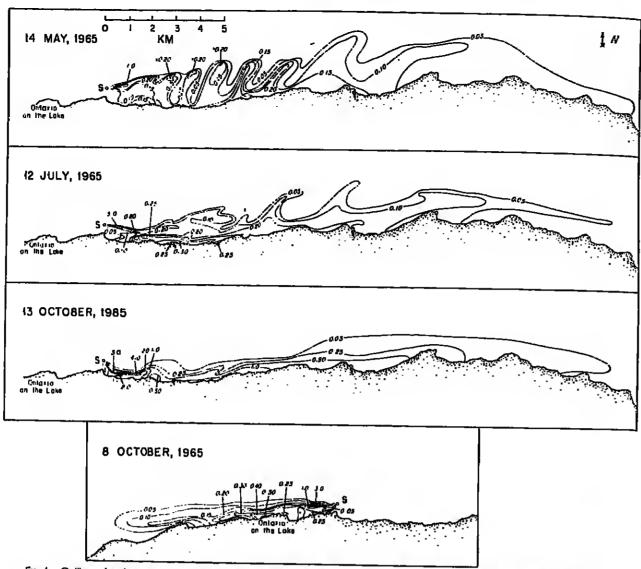


Fig. 4. Outlines of a plume generated by the continuous release of frecer dye from a nearshore source in Lake Ontario. Contours are tines of constant concentration in parts perbillion (Pritcherd-Cerpenier, unpublished report, 1965; evaliable from the authore, 208 Macst-pino Road, Ellicott City, Md.). When the coastal current reverses direction, previously developed dye plume disappears through efficient mixing with offshore waters.

bulent Ekmen layer' develops, the depth of which depends only on wind stress and Coriolie parameter. At mid-talltudes, the typical Ekman leyer depth is of the order of 10 m.

Wilhin the Ekmen leyer, e longshore wind stress causes Iransport to the right of the wind." To eetisty the coastst constreint, e compensating return transport occurs, evenly distributed over the water column. Where the longshore pressure gradient vanishes, this return flow gives riee to an unbalenced Coriolls force, which accelerates the water alongshore. Similar cross-etream displacements are deduced in other geostrophic adjustment problems, and the phenomenon will be referred to as 'adjustment drift.'

Sea level gradients ere generally not negligible in the longshore balence of torcss. For example, in a closed basin, wind setup is e well-known effect. When the wind blows along the longer axis of a long and narrow besin, such es Lake Erie or Lake Ontario, the level at the downwind end of the basin rises appreciably. In typical cases in Lake Erie, the level rise is of the order of e meter, e sufficient amount to affect the output of the hydroelectric power plant on the Niagara River.

In a basin of veriable depth, 'setup' balances the wind only at the locus of the cross-sectional everage depth. Shoreward from this locua, in shallower water, wind stress dominates and acceterates the coaatal water mass downwind. In water much shellower then the everage depth, the pressure gradient torce essociated with setup is negligible compared to the wind force, and the previous remarks on flow without long-shore gradient apply. In deep water, the pressure gradient dominates and causes return flow.

fn a cross-shore transect, given a pressure gredient that opposes the wind stress, interior velocities of the developing quesi-geostrophic tiow are similar to those shown in Figure 2. However, the cross-shore molion below the Ekmen leyer, which compenastes for the Ekman drift, is now pertly geoetrophic flow associated with the longshore pressure grediant. Where the depth is equal to the section average depth, geostrophic cross-shore tiow exactly compensates for Ekman drift. In much shallower water, the compensation (in the tronsient case) is mostly through adjustment drift. Longshore acceleration is only produced by the adjustment drift component.

The ebove theoretical tramework of quasigeoatrophic current gonaration has been emply confirmed by observations carried out in Lake Onterio during the Intarnational Field Year on the Great Lakes (IFYGL, carried out 1972–1973). At 5–10 km from shore, transient currents were tound to have peak trensporfs of e magnitude close to thet expected from the wind strees impulse. The corresponding cosetal-lake-level rise was documented. Although the cross-shore edjustment drift was not evident in current meter records (which were dominated by alrenger signals), they could be inferred from the displecement of constant property eurices.

Quasig ecatrophic longshore currents were elso found to be responsible for a reither dramatic difference in current climetology in the Great Lakes between the coaetal zone (of order 10-km width) and further offahore. Neershore, we'er motions ere mostly streight-line and ehore perellel, turiher awey thay are dominated by inertial oscillations es already illuefrated in Figure 1. Lagrengian tracer studiee in the coast-

In the Northern Hemisphere. All other epecific exemples in this ericle refer to the Northern Hemisphere, and the effects of the Coriolle force are discussed as they apply to those cases. In the Southern Hemisphere, of course, the Coriolls force ects in the opposite direction.

al zone show long plumes hugging the coast in one direction or another (Figure 4). Trecer released more than 10-km offshore moves in a much more erratic menner, i.e., in sessentielty all directions of the windroae.

Lagrangian tracer studies also show the more or less complete disappearence of a tracer plume on the reversal of the coastel current caused by an opposing wind impulse. The adjustment drift is thus seen to perform the very important preclical task of renewing the coastat water mass. For e strong enough wind impulse, the renewal is more or less complete.

Similar quaelgeostrophic transishi currents have also been well documented over continentel shelves of the Pacific type. The continental shelf off Oregon has been the subject of Intensive observational studies now for almost two decades. Much of this work has been oriented toward the understanding of the eeasonal upwelling cycle and its biological implications, but a considerable smount of evidence was also accumulated on the dynamics of wind-driven transient currents. Longshore wind impulses were found to be associated with longshore current fluctuations that were distributed more or less evenly over the water column (below the surface leyer). The coastal see level ross and fell in step with auch fluctuations. The presence of an adjustment drift could be inferred from the movement of the constant property surfaces.

Upwelling, Downwelling, and Coastal Jets

The distribution of water properties, selinity, temperature, nitrate and phosphete concentration, etc., is particularly especially expensive to the circulation in a cross-shore transect because the stresmlines of such circulation often cross sherp gradients. The gradients eriss on eccount of the streiffication of the wafer column that characterizes the coeetsi ocean in the eummer sesson. A warm (and fresh, over continental shelves) leyer of eome 20-30 m overlies colder end deneer water, and the region seperating the two layers (the sessonsi pycnocline) is relatively thin, so that it may often be thought of as so interfece between two fluide of silghtly different deneity.

tn a stretified water column in static equilibrium, surfaces of constent temperature and selinity ere horizontal. Crosashore particle dieplecements associated with trensient winds distort these euriaces in a cheracteristic way, depending on whather the cross shora circulation is 'upwelling' or 'downwelling.' These terms rafer to the upward motion of bottom water or the downward motion of surface water, respectively.

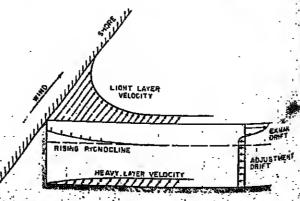


Fig. 6. Cheracteristics of rising coastat jet. Motion of pycnotline is only algorithm in a narrow coastal band (typically 5-10 km wide).

Upwelling mey cause those surfaces of constant tampersture and sainly, which in stelle equilibrium form a pycnocline or relatively sherp density interfece, to this reset the free surface. Conversely, downwelling may lead to the same surfaces intersecting the bottom at a depth several times their equilibrium depth.

As eurieces of constent density depart from their horizontel anullibrium position, hortzontal preesure gredients sriee in the fluid and affect the edjustment process to geostrophic balance and any resulting sleady stete of motion. A simple and resilistic theoretical model consists of two layers of conelant denelty separated by e frictionless interface. Cherney'a 11955] analysis dealt with this model and resultadin a quasigeostrophic edulion for an infinite etreight coast, conetent depth, and suddenly imposed longahore wind on the essumption that the verticel excurston of the pycnodine ts smell ('linearized' theory). The principal difference between this and tha homogeneous fluid case to thet within a nearshore band only the top layer fluid reeponds to the wind by longehore ecceleration, the bottom layer remaining quiescent. Consequently, higher longehore velocities arise in the top teyer. At the eame time the interface begins to rise or sink (depending on the direction of the wind) in euch s way ae to compensate for the euriece level rise and to hold bottom pressure (neerly) constant. The strong surface layer current lethen in geostrophic equilibrium with the horizontal pressure oradient essociated with the inclination of the density interface and is legitimetely celled a coastal let (in analogy with the almospheric jet stream, which has a similer dynamical slructurei. The cherecterietics of e rising coeetsi jet are illuetraied here to Figure 5.

As the coestal jet develops, the Interisce rises or sinke in a neershore bend of e width compareble to the Internet radius of deformation, which in typical coastal oceanic cases le 5-10 km. Fer outside this bend, the bottom layer moves bodily shoreward or seaward, while the top leyer has to accommodate the Ekman drift in the opposite direction. Consideration of the for velocities then reveale a pettern exactly as if there were no deneity gradients, which was illustrated for a sloping beach model in Figure 2. Very close to the coset, however, there le little motion in the bottom tayer. In the top layer, in the usual case when top-tayer depth to about equal to Ekman-

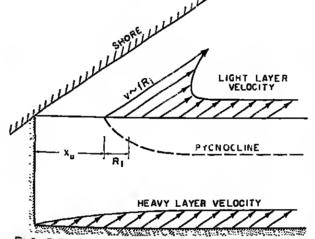
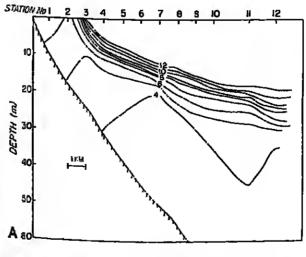


Fig. 8. Fully upwelled pycnocline tollowing a strong enough wind impulse. Light littld hes moved bodity offshore, end the boundary between light and heavy littld forme a aurisce front some datance from the coast. The coastal jet moves out from the coast with the pycnocline.



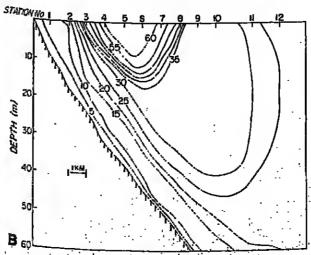


Fig. 7. (a) Distribution of isotherms (*C) in cross section of coastal region of Lake Ontario, observed during iFYGL, following strong wind impulse. Surface troni is seen about 3 km from shore. (b) Distribution of longshore velocity (cm e⁻¹) observed on the esme occasion. Core of the coastal jet like between 4 and 7 km from shore. (From Ceanedy, [1977].)

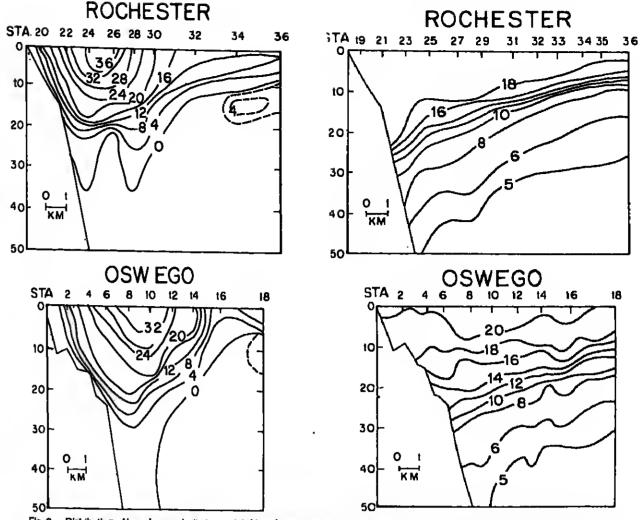


Fig. 8. Distribution of longshore velocity (cm s⁻¹, teft) and temperature (°C, right) of two cross aections of the coestal region of Lake Onterio, also from IFYQL. The difference between this case and the previously filtuatrated one to the tithe velocities are here directed so as to have the coast to the right (i.e., point out of the picture), whereas in Figure 7 they point the other way, into the picture. Geostrophic balance of the coasts! jet requires upwelling in the previous cess, downwelting in this cess. (Adopted from Csenady and Scott | 1974|.)

leyer depth, cross-shore molions ere negligible, and the force of the wind is evenly distributed over the lop leyer end causes uniform longshore scelerellon. Where the top-leyer depth is coneiderably greeter then the Ekmen-layer depth, edjustment drift occurs below the Ekmen layer, but in the top leyer

The most impressive results of upwelling and downwelling are the surfacing of ieopycnels some distence from shore, or their sinking to e depth severel times their equilibrium depth. The simple classical model, which postulates small vertical pycnocline excursions, does not apply to such cases. A strong longshore wind impulse is usuelly the cause of 'full' upwelling or downwelling events, with the large pycnocline dieplacemente developing quite repidly, often within hours or at most s day. It is ressonable to idealize these evente by eupposing that the wind impulse is evenly distributed over the top layer by vigorous turbulence. One may eek then how the two-layer fluid adjuets to geostrophic equilibrium tottowing such an impulse, with interface and bottom triction neglected and the deneity of each layer asperetely concerved.

The extension of the classical theory on the beels of thie idealization is relatively streightforward; if makes use of the principle of potential vorticity conservation [Csenedy, 1977]. Quantitatively, the principal new result is that the velocity of the coastal jet is limited to a value about equal to the 'densimetric velocity' in the esme way as maximum velocities are in ceriein 'critical flow' problems in hydraulics. The longehore momentum balance is completed by the Coriolle force ssecolated with the bodily displacement (edjuatment drift) of the entire top layer from shore to a dietance of the order of a few kilometers (Figure 6).

It should be pointed out here than an offshore wind also causes upwelling end, if strong enough, may bring the interface to the aurisce. However, the flow pattern so generated le not in squilibrium without the wind ecting, and the interface relaxes to a horizontal position on the cessation of the wind. Thus, in theory, the upwelling caused by a longshors wind is long-lived, an upwelling that is due to an offshore wind ephemerel. In practice, of courae, dissipstive processase cause the inclined interface that is in geostrophic equilibrium with a coastal jet to relax toward static equilibrium, but this is usually a slow proceee, with a typical time scale of 5 days or

Intense upweiling events are known to occur in a number of coastal locations, notably in the Great Lakes and along the Oregon coast. Early reports described the hydrography of upweiling, while leter aystemetic etudies, in the course of large-scale cooperative experiments, provided detailed information slee on longshore and cross-ahore currents [Smith et al., 1971; Smith, 1974; Mooers of et., 1978]. In the course of these investigatione, come clearcut upwelling events have been documented. They were produced by a local clongahore wind impulse, and the observed properties of these events compared well with the above simple conceptual picture.

During the international Field Year on Laka Ontario, upwelling events in Lake Ontario could be observed with considerable spatial resolution. Figure 7 ahows a well-documented event that occurred in October 1972. The wind stress impulse on this occasion wee large enough to produce offshore displacement of a fully upwelled thermocline of aome 3 km. The structure and intensity of the coastal jet, as well as the laotherm (= constant density surface) distribution, was very much as expected from the aimple theoretical model described above.

el described above.
Exemples of downwelling and associated coastal jats heva elso been documented in the Great Lakes. An example is shown in Figure 8, Trita also conforms in ell essential aspects to the finite displacement quasignostrophic model.

Acknowledgmenta

This work has been supported by the Department of Energy under a contract entitled Coostel-Shell Transport and Diffusion. A fuller, more quentite tive version, will be published in 1991 in Advances in Geophysics.

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Gabilel T. Caanady has been a senior scientiet with the Wooda Hole Oceanographic institution, Woods Hole, Mase., eince 1973. He was educated as a mechanical anginaar (Dipl. Ing., Munich) and worked 6 years in the electric power generation industry in Germany and Aughaita before emberking on graduete work on eir pollution maleorology. He received his Ph.D. from the University of New South Water in 1958. He joined the University of Waterloo, Ontario, in 1963, where he was professor of mechanical engineering and department chairmen for a period, while also beginning a series of experimental and theoretical attales on the dynamics of coastel our rents in the Great Lakee. In the late abtiles these attales were carried out incooperation with the Great Lakea Institute, University of Toronto, and were alimulated by extended visite to the Department of Meteorology, University of Wisconsin, Madison, increasing involvement with coastel oce anography led to the move to Woods Hole, where he worked mostly on dynamical problems of continental shelf circulation, with special smphasis on the coastel boundary fleyer. He was a ditor of the green JGR for a 4-year term, anding in December 1979, and currently edits a book series on environmental tuid mechanics (Reidel Publishing Co.). He is a reolphant of the President's Prize, Canadian Meteorological Society (1975), and the Chandler-Misener Award of the international Association for Great Lakes Research (1977). He is author of the monograph, Turbulant Diffusion in the Environment' (1973) and is currently working on enother monograph entitled 'Circulation in the Coastal Ocean.

News

The Love Canal: Beyond Science?

When In 1978, the New York State Oppartment of Health Isaued tha roport, 'Love Canal-Public Health Time Bomb,' the serious offecte of chomical waste confamination in the Love Canal area became an Issuo of netional concern. A fow 'studiea' eince then have produced rosulle in concert with fluose of initial reports that described 'conditions of acute health effecta as being linked to hazardous wastes incorporaled in landill in the Love Canal site near Niagera Felia, New York. Now that a biue ribbon' panet of experts from the medical sciences has reviewed the problems of Love Canal, however, a different viaw has emerged. The 'Report of the Governors' Panel to Reviaw Scientific Studies and the Devalopment of Public Policy on Problems Resulting from Hezardous Wastea, transmitted in October of this year, identifies the following factors about the health effects at Love Canal:

- Inodequata reseerch designs for health effects studies. particulerly regarding chromosome damage and informal surveys of the Love Canal roaldente;
- the inevitobla necessity of time required for longitudinal prospective studies end complex retrospective studies that concern long-term exposures to hazardous wasles.
- Inadequate intergovernmental coordination and cooperation in the design and implementation of health effects stud-

It is apparent that in the 2 years lotlowing rolease of the original Naw York Department of Hoalth report, a most difficult state of allnirs developed. On one hand, there is clear evidence that contrimination of the subsurface, groundwater, end household basomont areas of the Love Canal resilionis occurred (toxic chemicals, including chlorinated hydrocarbons and dioxin, among many others). On the other hand, there were no short-tarm health problems, eccoiding to most studios. The result was a state of understandable hysterio of the residents of Love Cenal because of the dangar of long-term' health problems such as the davelopment of cancer, birth defects, and other conditions that might be produced by chromosomal damage. The real problem is that, according to the recent illnding of the governor of Naw York's panel, the science is not well on ough developed to underaland, much loss to provo, a causal rolationship.

The clarm reisod in 1978 was, In part, a legal requirement of state law section 1388 to insure adoquate jurisdiction and resources for governmental response to the Love Canal situation. To obtain support for a 'nationaldisaster,' the Now York Stale Dapartment of Haalth had to deline the disester. Unfortunately, the state of lear and anxiety that resulted led to an unfortunate test of the scientific niethod. The panel re-

This Penel racognizas that there was a reason for the State Health Department's initial announcement of 'Pubitc Health Time Bomb, but not a good arough reason. There ought to be a better mechanism for convincing the Fadarat government that a certifieble disaster area exists, in order to obtain Federat funds, than to arouse such laars of imminent peril as swept through the Love Canal area in this case. A better mechanism might have been found it affective Federel/State consultations had been launched promptly when the problem wes lirst recognized. It may be that the atmosphare of public nearhystaria which was created in mid-1978 contributed to the tailure on the part of public health agencies to pul together en approprietely orderly, deliberative and systematic investigation of the situation.

This Panaf acknowledges that the Love Canal problem was somathing quite new, e situation not encountered before by public health egencies. In the past, Instances of environmental pollution emerged ae sudden acute episodes, usuatly darived from a single industriel source, with readily discernible and quantifieble heelth hazards. Love Canal, in contrast, represented the chronic contamination of a whole community's living space, extending back over a period of decadaa, and most complex of ell, involving not one but scorea of diffarent chemicals seeping through the earth and into households all at once. No book of rules axists for handling this kind of problem, but from now on it is obvious that rules will have to be formulated.

The Environmentel Protection Agency (EPA) released a study of the problem that the penet describes es 'a paradigm ol edministrativo ineptilude. Although the EPA qualified its findings to be used with 'prudence' because of Inadequecies dy. The findings were widely distributed, nonetheless According to the panel roport:

The public was given the strong impression that tha Lovo Cenni pottulion was ondangering the survivel of all contacts and their offspring. During the next few weeks the Biogenics roport (bass of the EPA lindings) was revlowed by sevorat groups of experts in the field of cytogenetics, with exprossions of doubt that the reported rosults wore of significance. These wore particularly critical of the techniques omployed, the tack of controls, and the possibly artifactual nature of the supernumerary acentric fragmants.

With so much at atako for the reeldents involved, to have set up experiments that lead to public conclusions of such magnitude, without prior review of the protocol by qualified uninvolved peer scienfiste, and without any efter the fact, independent review of competent scientists before release of the results, was a disservice to tha citizens most intimately concerned and, as well, to the

It is a pity that this matter was so bedly handled. There was no good resson why the responsible authorities in EPA could not have consulted beforehand with their counterparts in the New York State DOH, and enlisted the advice and close participation of outsida concultants

with international reputations in the field of cytogenetics, and then mapped out a thorough, careful and sciantificelly valid approach to the question of chromosome

There is now no qualion that e proper cytogenetica study is urgently needed. The Panel does not know whether the dagree of chromosomal injury claimed in tha 8 logenics Laboratory study, even il confirmed, is in ilself a reeson for alarmed predictions concerning cancar or congenital datects-indeed, similar chromosomal abnormalities are charactaristically observed in other circumstancea (measlea, lor axemple) without known sequeiae. However, the mere lact that the chromosomal damaga is real-if it ia-means that the residents of Love Canal are baing biologically affacted by something in their environment, and this observation-II confirmed—would greatly weaken the position, taken by some, that the only ill effects auffered by thie population are psychologicat.

There will be, no doubt, countless etudies of the Love Canal incident in the luture. The U.S. Public Health Service, the Nationel Academy of Science, and the New York State Department of Haalih will initiate studies or maintain progress in studiee now underway. Perhaps science will benefit by these studies, and, possibly the forefront of environmental/health research will be extended. Right now tha important questiona about cause end effect, risk assessment, and acceptable levels remain unanswered.—PMB &

Postal Cancaliation From Spaceport

The John F. Kennedy Space Center, in cooperation with the United States Postal Service, is offering a cancellation service to intereated philatellets for the apace flight progrema

Philatelists who wish to avail themselves of this service may do so by following the procedures outlined below:

- Specify the event for which you wish this eervice. There is a limit of live covers per customer per event.
- All covers must be aelf-addressed and bear at least firetctass postage or proper postage for international mail, placed thrae quarters of an inch down from the right top of the cover. Envelopes should contain a filler not to axceed the Ihickness of a postal or computer card to assure a clear cancellation. All inquiries must be accompanied by a stamped, self-
- addresead envelope. Raquests for service must be recaived at least 5 days prior to an avent, but no earter than 30 days before.
- Requasts should be sent to Chief, Mall and Distribution Servicos, Si-SRV-1M, Kennedy Spaca Centar, FL 32899. Services not provided are:
- requesta for personelly autographed covers, or for carrying covers on board during flight or prellight activitias; cachet service (rubber slamp) for such major events as the firel launch of the space shuttle:
- hand-back service.

Since the Kannedy Spaca Canter post office is open only Monday through Friday, excluding legal holidaya, anvalopes cennol be cancelled on Saturday or Sunday. Cancellationa for minor tests cannot be given because access to these schedules la not available. S

Radio Astronomy in Earth Studies

A high pracision radio astronomy system has been adopted end usad at the Goddard Space Flight Center in etudias of the movament of the earth's crust. Very Long Baseline Interferometry (VL8I) can measure the rotation of the earth, and polar motion, with a currant precision of better then 10 cm. Such precise measurements may shed light on the relationahip between changes in the aarth'a orientation and movements in the eerth that are esecclated with large eerthquakas. Such movements may occur before an eerthqueke, but so slowly end over so lerge a region es to be undelectable by conventional means. Using VLBt stationa, the Cruetel Dynamics Project has mede measurements on the longer baealines to messure continantal drift, and on the ehorter on as to monitor regional activity.

The technique usas two or more entennas to observe fixed extragalactic acurcas, usually quasers. Applying this princip le to Eerth crusial studias, the quesarrival limes et lhe two etetions can be used to geometricefly iar signal 's diffarance in determine the dislance between the two stations with a high degree of eccuracy.

The baseline, or streight-lina distence, between stations et Westiord, Masaachusetfs, and 8ishop, Californie, has been measured with a pracision of 3 cm, or better than one part to

Formation, with other countries, of a global stetion natwork and some of its work were raported by geophysicist Chopo Ma at the AGU Fall Meeting in San Francisco, Decamber 10. Ma reported that a number of lundamental questions in geophysics are now being inveatigated by using space techniquea. What le the nature and magnitude of lectonic plate mollon? Whel te tha behavior within e plate, eapecially conti-nentel platas auch as North America? What ta the relationehtp between fluctuations in the earth's rotation and large

The VLBI method is now using a highly senaltive, accurately calibrated, automated system (Mark Iti) which to designed for making gaodalic measuremente with fixed or mobils radio astronomy antennas of various sizes, renging from 4 to 84 m In diemater. The project has conducted geodetic observations with the Mark III systems at itxed radio astronomy atations in California and Messachusetta, mentioned earliar, end af Green Benk, West Virginia; Ft. Davis, Texas, Onsala,

Swaden; Bonn, W. Germany; end Chilbolton, England. Tha Crustal Dynamics Project group at the Jet Propulsion Laboratory le implementing the Mark III system toto a mobile alation for measurements of crustal movements in the western

Since 1976, measurements from Massachusetis to Wesi Virginis and California indicate oversii continental stability. I.e., no more change than 2 cm/year. The bas alines to Texas liret maaeured in April 1980, will ellow more datalied examination of the eastern and weetern ecctions of North America. Many measuremente hava bean made in California since

that le an area of known regional ectivity. In cooperation with the National Geodetic Survay end several international organizationa, VLBI maasurements were mada by NASA in July, September, and October 1980, se part of the Monitoring Earth Rotation and Intercomperison of Techniquas Program. These data, equal in amount to whet waa acquired in two previous years, are now being analyzed end are to be published next apring. Thay will provide unprecedanted opportunities to compare tha details of the earth's orientation as determined by other techniques and lo check the United States-to-Europe baselines for plate motion and etablility.—PMB 32

New Marine Studies Center

Temple University has established a Center for Marine Studies with faculty membere from four of its collegas. Tha center will offer courage leading to a certificete in marine

Studiea will locus on urbanization's impact on the marine environment and wilt focus on menagement end economics of waterfront utilization, to addition, faculty members will be constructing an artificial real off Abeacon inlet to determine if increasing protective environments will permit tricraased eport Hehing.

Course offerings will range from oceanography and marine biology to scuba diving and underwater research and data

For additional information about the center, contact Robert Leahy, Oirector, Center for Marine Studiee, Tempia Univarsity, 209 Seury Hall, Philadelphia, Pennsylvania 19122 (call

Weather Predictions on Target

The western third of the United States will be warmer and dryer than normal this winter, according to Jerome Namias, a metaorologiet at the Scripps Institution of Ocaanography's Climate Research Group. Howaver, the East coast will be coldar and wetter than normat, he pradicted. Thas a predictions, made early in Decembar, have provan correct through the beginning of Januery.

'indications point to colder than normal tamparatures over the eastern half of the nation and also over the Southwest from New Mexico through Oklahoma and Texas, and warmer than normal temperatures ovar the weetern third of the netion, said Namias, a principal investigator for Scripps' North Pacific Experiment (Norpax). Florid a will probebly experience near-normal temperatures.

A major change from last winter's weather, the predicted pattam is the result of e trough in the pravailing winds between 3,000 and 12,200 m. Last winter's weether was mild from the Great Pisins eestward to New England, dry and reiatively snowless over much of the Easi, but eb normally wet over the Southwast, particularly in California.

This winter, the preveiling-wind trough is expected to exlend from New England southwestward to Texas, where e strong ridge is expected over the Cenadian Rockies and

The Influence Of Man On The Hydrological **Regime With Special** Reference to Representative and **Experimental Basins**

Proceedings of the Helsinki Symposium June, 1980

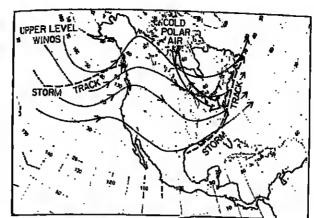
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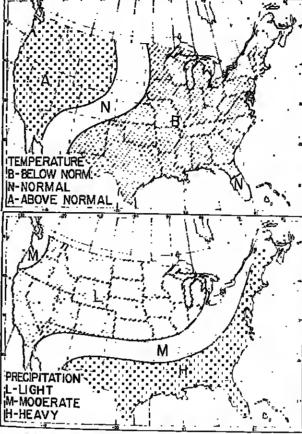
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Predicted for winter (December 1980, January and February 1981). Source: Scripps inellitution of Oceanogrephy.



Predicted for winter (December 1980, Jenuary end February 1981). Sourca: Scrippe Inetitution of Oceanograp

along the Wast coast. This wind pattern would encourage movement of cold poter sir masses into the East but would shield the West, Namlas explained. Thie pettam siso favors more frequent etorm e along the Gulf Coaat and the Atlantic

In the East, some of the snowe, once generated, would inlivence the atmosphere that would lurther refrigerate the air, he seid. By increasing the temperature contrast between the continent and the Gulf Stream, development of East coast storms would be enhanced,' Namias adds.

The Dakolas, Nebreaks, and parte of Colorado, New Mexico, and Arizona, which lie in e region between the above and nesr-normal lampereture zonee, will experience targe weekly temperature fluctuatione that will average out to near-normal temperaturee for the eaason.

Namiaa' westhar-prediction tachniquee utilized, in part, dela on ocean-water temperetures as indicators for changes in climate ovar the continenta. 33

Federal Coal Directory

Anew catalog thet provides the addresses and the telephone numbers of more than 400 national end local coelrelated officea of the U.S. Geotogical Survey, Office of Surface Mining, end the Bureau of Lend Manegement is evalable from the USGS.

The 41- page publication, a cooperative effort of the three Oepartment of the Interior agencies, contetna e elatement of State of selected he edquarters offices and field offices.

Single copias of the new publication, 'Cetalog of Selected Offices of the Office of Surface Mining, 8 ureau ol Land Management, and the Geological Survey Relating to Coal, 1981 (USGS Circular 840), may be obteined free of charge from the USGS Branch of Diatribution, 604 South Pickett Street, Atlington, Virginia 22304. 88

Atmospheric Sciencea Assistantahips

Research assistentables for greduate atudants in the athospheric sciancee ere avalleble from the National Center for Almospheric Research (NCAR). Research topics should cover simoapharic dynamics, climatology, cloud physics, atmospheric chemistry end radietion, upper atmosphere physics, solar end space physics, oceenography, or environmenlal and societal impect assessment.

Appointments are helf-time and offer seferiae of \$6085 for students who have pessed comprehensive examinations and \$7520 for those who heve not. Maximum fenure for Ph.D. candidataa fe usually two years, but M.S. candidates ere usually restricted to 1 year. In unueuel casea, en additional year may be possible :

Additional informetion may be obtained from Betty Wilson. dministretor, Advanced Study Program, NGAR, P.O. Box 3000, Boulder, Colorado 80307.

Geophysicists

Neil H. Berg la now in charge of snowpack research for the Forest Service's Pacific Southwest Forest and Rangs Experiment Station in Berkeley, California. In hia new position, he will direct a team of acientists to study lorest management in the enow zonea of the Sierra Navada and Coast Rangea in



George A. Paulikes has earned a Truelee's Oistingula hed Achievement Award for 'outstanding international leadership in magnetoaphere phyeics and Ita applicatione to military space aystems' at The Aerospace Corporation. The award consists of a bronze plaque and \$10,000 cash.

Paulikaa, associate editor of the Journel of Geophysicel Research, 1972-1974, has been director of Aerospace's Space Sciencee Laboratory since 1988.



Atheistan Spilhaue will be a Distingulahed Scholar at tha Center for the American Exparience, Annanberg School of Communications, and a research fellow in the Institute for Marine and Coastel Studies, University of Southern California, Los Angales, from January through June 1981.

Herbert W. Sloughton joined the geodetic survey squadron of the Dafensa Mapping Agency at the F. E. Warren Air Forca Base in Wyoming.

Robert L. Waseon has been officially appointed assistent director for research at the U.S. Geological Survey in Reston, Virginia. He aucceeds Jamea R. Balaley, who retired a year ago. Wesson has contributed to earthquake research aimed at prediction and mitigation of quake hazards.

Geophyaical Events

This item comprise a a eelected portion of SEAN Bulletin, 5 (11), mber 30, 1980, a publication of the Smithsonian Institution

Volcanic Activity

Mount St. Helans Voicano, Cascada Range, southern Washington, U.S.A. (48.20°N, 122.18°W). All timea ere local (GMT - 8 h). After the explosions of October 18-18 end tha brief period of leva doma growth that followed, activity at Mount St. Helens was limited to vapor amiealon and occeelonal selamic activity through eerly December.

Most early November selamic events were caused by rock sildes from the creater walls. No algnificant local earthquakes or harmonic tremor were recorded until mid-November, whan brief apisodee of harmonic tremor began, berely within fha datection limits of eeneltive selamographe on and near tha volcano. Infermittent low-level tremor continuad through early Oecember. Strongar tremor started on November 25 sf 2054, gredually lading into background noise about 35 min later. Observers in a U.S. Foreet Service el rcraft reported s afightly brighter glow in the dome area after this event. A secand burat of stronger fremor began Novamber 27 at 2034, continuing for about an hour, end saveral more auch episodas, lasting only a few minutes each, were datected through November 30.

U.S. Geological Survey monitoring of the north crater rampart revealed a maximum nat outward movement of about 23 cm between the October explosions and November 28. However, a major reversal to inward movement occurred in lete October before an outward trend resumed in November. Outward growth accelerated in mid-November to alightly more than 1.5 cm/dsy st fimas, a rete similar to thef recorded dur-

22 July (7) 2.2 7 Aug. (10) 🜑 2.0 12 June (9) 1.9 0 25 May (11) 18 May (9) ERUPTION DAY (18 May = 1) Esecntial Ejecta (14) = number of analysos 7 Aug. (16) 22 July (7) 5.2 12 June (9) 25 May (11) 18 May (9)

Fig. 1. (a) Average MgO and (b) CaO concentration in cruptive rocks from each oruptive episode at Mount St. Hetens, Mey tato August 7, plotted egainst time of each episode (May 18 - 1). Analyses are of fused powdere by the electron microprobe. Numbers in parentheses are the number of samples analyzed and included for

ERUPTION OAY (18 May = 1)

Essential Electa

(14) = number of analysea

Ing the summar. About 20 cm of expansion was measurad between November 12 and 26.

No major changas heve taken placa in the volume or ratio ol gasses emilted by the mountain. Two large tumarolas opened in the crater floor, very close to the margin of the leva dome, one on November 18 or 19, the other on November 25. As they opened, both ejected mud (containing no tresh magme) that coalad snow on the tlank. As of aerty Oecember, the new furnaroles were 2-3 m across, glowed cherry red, and puffed noisily et half-aecond intervals.

A small but definite trend towerd andealte compositions is revealed by mejor element anelyses of the 18 May to 7 August eruptives. A total of 48 eemples of probable sesential ejecte heve been analyzad (Table 1 and Figurea 1a and 1b) a minimum of five such samples from each aruptive eplaode. The trend is an irregular one end

is more pronounced with regerd to MgO end CeO when

Tha following le a report from W. G. Melson.

plotted ageinst time of eruption.

Information contacts: Tom Caeedevall, Chrie Newhell, and Don Swanson, U.S. Geologicei Survey Fleid Office, 301 E. McLaughiin, Vencouver, WA 98863

Robert Tilling, U.S. Geologice/ Survey, Stop 906, National

Center, Realon, VA 22092. Steven Melone, Robert Crosson, end Elilot Endo, Greduete Pregram in Geophyaics, University of Weahington, Se-

William G. Melson, NHB Stop 119, Smithsonian institute, Washington, D. C. 20560.

Paviol Voicano, Alaske Peninaula, Aleaka, U.S.A. (65.42°N, 181.90°W). All times are local (GMT - 10 h). An eruption from Paviol November 11-12 ajected large lava founfaine and ash cloude that reached 11 km sittlude end may have produced lava flowa.

A selemic afetion 10 km southwest of Paylof registered a 21/2 min buret of low-amplitude hermonic tremor beginning on November 5 at 1351. Emission of afeam, ash, and some .blocks from a vent high on the northeast flank started No-: vember 8 at 1047 and lasted about 5 min, without accompanying seismicity. A second burst of low-amplitude tremor

TABLE 1. Averages for Each Eruptive Episode of Mount St. Heisne, May 18 to August 7

mber	SIO ₂	Al ₂ O ₃	FeO*	MgO CaO	K ₂ O	Ne ⁵ O	ПО2	P ₂ O ₆	MinO Si	ım
1 2 3	64,13 64.19 63.72 63.49 63.28	17.61 17.92 18.04 17.87	4.04 3.99 4.24 4.44 4.39	1,88 4.90 1,91 5.06 1,99 5.16 2,20 5.22 2,17 5.30	1.28	4.63 4.63 4.70 4.97 4.89	0.58 0.50 0.64 0.57 0.64	0.15 0.15 0.15 0.15 0.15	0.00 96 0.00 96 0.00 100).18).94).89).17

Electron microprobe analyses of fused powders by W. Melaon, T. O'Heam, and J. Nelen, 8mithsonian institution. Samples collected by

1, May 18 sverage rins analyses; 2, May 25 everage 11 analyses; 3, Juna 12 average nine analyses; 4, July 22 average nine analyses; 5, August 7 average 10 analyses.

Total iron calculated as FeO.

occurred between 0536 and 0541 on Novembar 9

in contract to the pattern observed before eruptions in 1973, 1974, 1975, and 1976, virtuelly no addillonal seismic ectivity was recorded until a group of seven tow-frequency volcenic earthquekee occurred at about 2300 on November After an explosion event appeared on selsmic records at 0243 on November 11, 10 more low-frequency volcenic oarhquakes were recorded between 0300 end 0400. Conlinuous hermonic tremor, of feirly low amplitude, began of 9608, but amplitude internation eround 0900.

Reeve Aleutian Airways pitot Everett Skinner sew rocke up to tim in diemeter rising 10 to 30 m et 1315 on November 11. An observer in Cold Bay, 80 km to the West, noted an increase in activity about 1600. Skinner roturned to the vicinity of Pavlot between 1630 and 1700, reporting tava tountaining from the aummit, a black cloud hugging the volcano's upper north tlank, and an eruption column reaching an estimeted 6 km attitude. Between 1800 and 2000, various witnesses reported lava lountaining to a maximum height of 300 m and incandeacent material moving down the north tlonk. A satellile tmage returned at 1958 shows o nearly circular plume, 15 km in diameter, north of the votcano. Activity was visible through the night from Cold Bay (see above) and the Send Point areo (50-65 km to the east northeeet).

The noxl morning, et 0948, a satellite image reveeled a plume 160 km long end elmost as wide apreading north of Paviof. Specirel en etyels end we ether balloon deta indicate that the plumo reached 8-9 km above sea level. Pilot reports on November 12 ploced the top of the gruption cloud at 9 km ot 1000, 6 km el t 100, and t 1 km at 1400. The eruption clouds were described as varying from esh-rich to ash-poor. A helicopter crow from KENt lolovtsion, Anchorage, videotoped pulses and bursts of lavo fountning, rising 150-300 m between 1600 and 1700. The jounintne emerged from o preexisting vont high on the northoost llank, the only vont confirmed active during the oruption.

 Vory high amplitude harmonic fremor occompanied the oruption, reaching its strongest levels between 2000 on November 11 and 0700 on November 12. Tremor ceased at 1835 on Novembor 12, at which time many B-type earthquakes begen to be recorded.

By the morning of November 13, the eruption had ended. Several hundred B-type events por day were recorded Novombor 14-15. Ronowed high-amplitude tremor began November 15 at 1306, tasling until 17t1. B-type aorthquakes continued November 18-19, but lower than 100/day were re-

Information confacts: S. McNutt and J. Davies, Lamoni-Doherty Geological Observatory, Palisades, NY 10964. Alison Till, U.S. Geological Survey, 1209 Orca St., Anchoroga, AK 99501.

Jürgon Klenle, Geophysical Instituto, University of Alaska, Fairbanks, AK 99701. G. Roberts, Cold Bay Weather Stalion, Cold Bay, AK

Commander John Hair, Chiel. Marins Environmental Branch, P.O Bex 3-5000 (MEP), Junoeu, AK 99802.

Garoloi Volcano, Alaulian Islands, Aleska (51.80°N, 178.80°W). All times are local (GMT - 10 h). On August 10 and 11, SO, from a fresh volcanic plume was delected from a research eircraft (flown by NASA under contract from the U.S. Oepartment of Energy) et 19.2 km eltitude just south of

Anchorage, Alaska. Imagery returned August 8 at 1010 by the NOAA 8 Setellite shows a high-altitude plume appearing to originate from the vicinity of Gareloi. Using e drift rate of 30 km/hr, Los Alamos Scientitic Laboratory personnel catculated that the eruption which produced this plume had probably ended about 10 h earlier. Later visuel and infrared images show the plume moving loward the Anchorage aree, about 2000 km from Gareloi, at a rate that could have brought it to the sampling area by August 10. The eruption column seen emerging from Gareloi August 9 by a commercial pilot was also gresent on satellite imeges, but clearly was not large enough and did not reach a high enough allitude to have been the source of the material sampled August 10-11. Wind conditions also preclude the August 7 eruplion clouds from Mount St. Hetens as a source for SO, In the Anchorage area at Ihts lime.

Information contacta: W. A. Sedtacek, G. H. Heikan and E. J. Mroz, Los Alemos Scientific Laboratory, Los Alamoe, NM 97545

Kralla Caldera, Myvatn Area, Icelend 185.7 toN. 16.75°W). The following is a report from Karl Gronvold.

After the October eruption the magma roservoirs et Kratla Intlated rapidly until the tast wesk of November. Ground level monitoring indicates that at that time land height over the mogma reservoirs was higher than betore the October gruption. During the week or so prior to 3 Decomber, the rate of initetion has been slower and moro trroquiar.

From the pattern of behavior so lar, an oruption can be expected to take place soon. Evocuation plans end civit defence measures have been strengthened in cese of an eruption in the southern part of the tiesure system, closer to the village near Lake My vatn.

Information contact: Kart Grönvold, Nordic Volcenological Institute, University of Iceland, Reykjavik, Iceland.

Langlia Volcano, New Britain Island, Papua Naw Guinee (5 53°S, 148.42°E). The following is a report from the acting

inlansified aruptive activity that begen in mid-October continued until 8 November. Dark amission clouds continued to be raiseeed from crater 2, and emission cloude from crater 3 were pale gray. Ejectione of incandescent lava fregments from both craters were accompanied by rumblinge and axplosion sounds. The lave flow from craler 3 was reported to be still active on 1 f November.

A dacline in the intensity of the eruption was evident on 8 November, when seismograph attenuellon was reduced by 18 decibels. However, glowe end ejections of incendescent leve fragments continued from both craters, and gray ash and vapor clouds continued to be

Information contect: Acting senior voicanologist, Rabaul Observatory, P.O. Box 386, Rabeul, Papua New Guinsa.

Kavachi Voiceno, Solomon Islands, Southwest Pecific (9.03°S, 157.93°E). Soleir pilota flying over Kevachi Volcano on October 14 observed a similar submarine eruption to that reported by Chief Pilot Sruce Kirkwood on October 7, allhough there appeared to be more mud in the surrounding sees then during the earlier activity. By October 23, ectivity had decreesed to occasional bursts of hot water at the sur-

Information contact: Deni Tuni, Geology Division, Ministry of Natural Resources, Honlara, Solomon lelands.

Volcenic Activity in the Philippines, September-November

Bulusen Volcano, Luzon Island (12.77°N, 124.05° E). Bulusan'a most recent eeh eruption, on September 28, wae followed by a seriea of volcanic earthquakes which became less frequent with time. Felt avents of intensity I to II on the Modified Rossi-Forel Scale have also occasionally been re-

Meyon Volceno, aoutheast Luzon Island (13.26°N, 123.62°E). Short-duration hermonic tremor weathrst noted ot Mayon on August 18. Occasional tremor continued Ihrough November, and as of November 30, 214 episodes had been recorded. Similar selemicity preceded the 1978 eruption and accompanied crater glow in July 1979.

Canloon Volceno, Negros Island (10.41°N, 123.13°E). Seismic activity el Centaon has lessened considerably since it stated on May 6, 1980, but remelned above normal as of tote November. Canjeon lest erupted in mid-1978, ejecting ash Intermittently.

Information contact: Olimpio Peña, Acting Commissioner, Commission on Volcanology, 5th floor, Hizon Bidg., Quezon Blvd, Ext., Quezon City, Philippines.

Myofinsho Subniarine Volceno, Mariene Islands, Japen (31.82°N, 139.92°E). All times are local (GMT + 9 h). The crewof the fishing boat Suitenmeru 11 saw discolored weter over Myojinsho on November 15 at around f 530. They reported that no discoloration had been seen there that morn-Ing. Parsonnel from the Jepan Maritime Salety Agency (JMSA) liew over the site on November 16 end observed three circular ereas of pale green water, each 50-80 m ecross, aligned within e 300 m zone. These were also seen the following day by the crew of the fishing boat Shinkomaru 26 and agein by JMSA personnel on November 28. No figat-

Ing elects or upwelling of water were noted, however. The November activity is the first since July 13, 1979, when JMSA observed discolored water. In 1952, 31 persons aboard tha research vesset Keiyo Meru 5 were killed by a violent phreetic eruption of Myojinsho.

Information contacts: Japen Maritime Sefety Agency, 5-3 Tsukiji, Chuo-ku, Tokyo, Japan. Seismological Division, Japan Mateorological Agency, 1-3-Otemachi, Chiyoda-ku, Tokyo 100, Japan.

Submarine Volcanos, Volcano Islands, North Pacilic Ocean. The Jepan Maritime Safety Agancy (JMSA) continues frequent monitoring tlights over several known submerina volcenoes (see table balow). The most active of these Fukutoku-oka-no-ba (24.28° N, 141.52° E), formed islends in 1904 and 1914, end discolored esa weter in 1950, 1952-1953, 1955-1956, 1958-1859, 1962, 1867-1968, and 1973-1980. Discoloration has also been seen occasionally over Fukujin (21.93° N, 143.47° E) each yeer since 1977. Minamihivoshi (23.50° N, 141.90°E) discolored seawater January-March 1977 and January-Merch 1978, but hes not been active since. An adjacent vent, Nikko (23.08° N, 142.32° E) hae shown no signs of activity eince July 1979. (See Table 2.) information contacts: Sema as for Myolinsho.

TABLE 2. Volcenic Activity et Three Sites in the Volceno Islande,

	Apin io October,	1660	
Dete of Observation	Fukuloku-oka-no-ba	Minami-hiyoshi	Fukujli
April 24	D	N	N
Mey 12	D	-	Ö
June 18	D	N	Ñ
July 7	D	~	
July 8	D	N	N
July 14	D	N	Ñ
August 18	N	Ñ	Ñ
September 4	Ň	Ñ	Ñ
October 21	N	Ñ	Ñ

D, discolored weter observed. N, no discolored water. Bisnk, no

Sekurazima Volcano, Kyushu, Jepan (31.58°N, 130.65°E). The number of explosions recorded at Sakurazime declined from 21 in September to 4 in October, then increesed to 21 to November (see Tebis 3). The highest October ash cloud reached 2.0 km on the tirst. None of the October activity caused eny damage. Laplill from the lergest November tephre cloud, which rose 2.5 km on November 8, broke tive car windshields. The sir shock from the November 28 explosion broke two windows in a hotel at the base of the volceno. No injuries were reported.

The November 23 axolosion was the 287th of 1980, making the year's total the greatest since 1974. Information contact: Selsmological Division, Japan Meteorological Agency, 1-3-4 Olemachi, Chiyoda-ku, Tokyo 100,

TABLE 3. Explosione From Sekurazime, October-November 1980

	INUITABLE OF EXPLOSIO
October	
1	1
18	1
19	1
24	1
Total	4
November	
1	2
2	1
3	3
7	2
8	2
9	1
10	1
13	2
22	. 1
23	2
24	3
28	Ī
Total	21

Asema Volceno, central Honshu, Jepen (36.40° N, 138.53° E). Monthly seismicity at Asema increased from 1114 recorded evants in September to 1350 in October (see Figure 2), the highest monthly total since August 1977. Seismic activity decreased to 897 recorded events in November. No eruption or increase in eleam emission were observed. Asame last erupted in 1973, when the number of earthguaksa reached 5812 per month.

Information contacts: Seme as for Sakurazima.

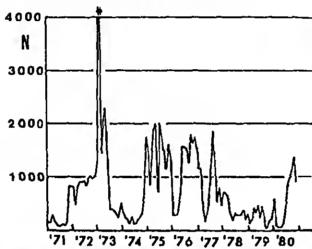


Fig. 2. Number of aelemic events recorded per month et Asama, January 1871 to Novembar 1880. The eruptions of February and Merch 1973 ere indicated by errows at the top of the figure.

Earthquakes

15.34°E

72.22°W

CHALL	Meduli	nge rannge
1028	7.4 M	41.18°N
1037	6.9 M	51,43°S
0658	5.2 m	13.09°5
1835	6.9 M	40.81°N
1738	4.7 m	8.10°N
le	Depth of Focus	Region
v	14 km	off the coast of north Cellfornie
	10 km	Attentio-Indian Ridge south of Atrica
٧.	ehellow	eouth central Peru
	1028 1037 0658 1835 1738	1028 7.4 M 1037 6.9 M 0658 5.2 m 1835 6.9 M 1738 4.7 m Depth of Focus V 14 km

The California earthquake caused a bridge collepse that injured six persons, but damage was generally light and no other injuries were reported. The Peru shock killed at least homeless. Caeualtiee and damage were concentrated in the San José area, 80 km aast of Ayacucho, About 25,000 km of south Italy were devastated on November 23. As of early Dacamber, official ceevalty figuree lieted 3105 ae killed, 1575 miseing, and preaumed dead, and 1871 injured. An eetimatad 200,000 were left homeless. The November 28 event injured 36 people and badly damaged 30 buildings in Cucuta. Colombie, on the Venezuelan border.

8 km

ehellow

aouth Itely

east Venezuele

Information contacta: National Earthquake Information Service, U.S. Geological Survey, Stop 967, Denver Federal, Center, Box 25046, Denver, CO 80225.

United Press International. The Associated Prees. The New York Times.

Fireballs

Atlantic Ocean, November 15, 2300 GMT. Observer: Cept. Zweigler, F/O Grat, F/E Kogeinig of Luft: hanee Flight SH 619, (Cerecas - Frenkfurt) Location: 22.45°N, 48.16°W, aircraft course 031° magnetio

First eighting: 76° megnatic, 30° ebove horizon. Leet eighling: 91° megnetic, 10° above horizon. Duration, 20,s.

Apparent brightness: like full moon. Color: white at the beginning, yellow et the end.

Size: about half of the full moon. The object initially possessed a smoky tail about 4 times the langth of its haed. When last seen, the firebell was separating into four or five pieces. A yellow afterglow lingered for

information contact: Garhard Poinitzky, Universitaets-Slamwarte, Tuerkenschanzstrasee 117, A-1180 Wien.

Attentic Ocean, November 17, 0108 GMT. Observers: Capt. Helle, F/O Behrendt, F/E Schmidt of Lufthansa Filght LH 421. (Boston - Frankfurl) Location: 42.53°N, 57.20°W, aircraft course 065° true, alti-

tuda 9.4 km. First sighting: 085° true, 40° above hortzon. Last sighting: 045° true, 5°-10° above horizon. Ouration: 3 s. Apparent brightness: like full moon.

Color: blue-grean, than yallow-red. Size: 1/4 ot full moon. informetion contect; eeme as above.

Austria, August 11, 2159 GMT. Observer: K. Frenger, Location: Gloggnitz, Austrie (47.68°N, 15.97°E). First sighting: right Ascension 21 h 20 min declination

Last sighting: right Ascension 18 h 45 min declination

Duration: 12s.

The fireball was first observed in the constellation Caphaus and disappeared in Lyra. It had an initial magnitude of -2, intensitying to -8 on explosion of the bolide. At this point, the shadows of nearby treee could be clearly seen. No notse was hsard. An afterglow was visible for 10 s.

Information contect: eame ae for Atlantic Ocean.

Czechoalovakie-Poland border, October 3, 2300-2400 GMT. The following is a report from Zdeněk Ceplecha.

A fireball of -- 10 meximum absolute magnitude was photographed by at feest 2 stations of the European network. The fireball traveled a 52 km luminous trajectory in 2.8 e. No visual observations are available and the tima of lireball passage is rather uncertein. The tollowing resulls ere based on 2 photographs of the Czech part of the network.

	Beginning	Maximum Light	Tarminal
locily (km/a)	18.8	17.8	18.7
eight (km)	73	48	43
titude	48.30°N	48.81°N	48.64°N
ebutign	18.73°E	19.11°E	18.18°E
epullude	-4	-10	-4
838 (kg)	9.8	1.3	0
R	58.0°	58.0°	58.0°

Firaball type: II. Meleorite fall vary improbable.

Radiani (1950.0)	Observed	Geocente	ic	Hellocentric
Alphe	345°	341°	_	
Oella	40	-2°		-
Lembda		_		301°
Bela	_			2°
tritial velocity (km/s)	18,8	15.2		38
Orbit (1950.0)				
A		4.0	A.U.	
E		0.8		
Q		0.88	AU.	
Aphelion		7.0	A.U.	
Omega		227.0°	7,101	
Ascending n	nde	190.45*		
Inclinetion	•••	2.0°		

Mateor shower: perhaps e bright member of Capricomids. information contact: aame as Czechoslovakia-Austria.

Czechoslovekie-Austria border, November 18, 011332 GMT. The tollowing lae report from Zdenek Ceplecha.

A ilreball of -12 maximum absolute magnitude was photographed by 6 Czech stations of the European network. The fireball traveled a 53 km luminous trajectory in 0.7 seconds. A prism spectrum with dispersion of 20 nanometers (nm)/mm in the blue region was photographed from the Ondrejov Obsarvatory. The atrongest tines belong to ionized calcium (393-397 nm), jonized magneslum (446 nm) and lonized ellicon (635-837 nm) and to neutral sodium (589-590 nm). Most of the medium and taint lines belong to neutral iron, magnasium, and calcium. The following results ere based on all evailable photographe and should be close to tinal values.

	Beginning	Maximum Light	Terminel
Valocity (km/a)	71.8	70.8	69.0
Heighl (km)	117.3	91.8	87.5
Latitude	48,821°N	48.850°N	48.855°N
Longitude	15.838°E	15.328°E	15.248 E
Magnitude	-3.8	-12.0	-4.2
Mess (kg)	0.19	0.02	none
ZR	55.8°	-	58.2°

Fireball type: III A I.

Typical cometery tireball belonging to the Leonid Meteor Shower (Parent Comet: Tempel-Tuttle). Meteorite tall Impossible.

The increase in brighiness during tha tiret hall-eecond corresponds to 17 etellar magnitudes per eecond (6 million times par second in light intensity), which is the biggest increase of brightness we ever observed for a fireball photographed within the European network. The sudden decrease of brightness after the maximum light corresponds to 100 steller magnitudes per second.

Geocentric

			~
Alphe Dalta	153.7° 22.04°	153.8° 21.88°	_
Lambde			149,1°
Beta		_	17.7°
initial Velocity (km/s)	71.8	70.8	41.5
Orbii (1 0 50.0)			
A		13 (±3)	A.U.

A	13 (±3)	A.U.
E	0.92	
Ō	0.9845	A.U.
Aphelion	25 (±8)	A.U.
Omege	172.7°	
Ascending nods	235,4483°	
Inclination	162.2°	

Informetion contact: Zdaněk Ceplecha, Ondrejov Observatory, 251 65 Ondrejoy, Czechoslovakie.

South Europe, November 11, 1736 GMT. Meny persons In Augtrie and Italy observed a brilliant lireball that traveled from northeast to southweal, diseppearing below the southweat horizon. Table 4 summarizes a law of the observetions. None of the observers reported eny sounds.

Information contacts: Maurizio Eltri end Enrico Stomeo, Via Marcantonio Bragadin No. 2, 30126 Lido, Venezia, Italy. Gerhard Poinitzky, Universiteete-Sternwarte, Tuerkenschanzetresse 17, A-1180 Wien, Austria.

iraq, October 5, 2256 GMT (October 6, 0156 local time). Observers: Capt. Schalzmann, F/O Meler, F/E Keller of

Swissetr Flight SR 198 (Alhens-Bombay).
Location: Ireq (33.33°N, 38.30°E), aircraft course 120° magnetic, altilude 10 km.

First alghting: 125° magnetic, 10° above the horizon. Lest sighting: 130° magnetic, et the horizon.

Duration: 2 s. Brightness: dazzling. Color: blue-white.

Size: about 1/4 of the full moon.

No tall was observed.

information contact: Gerhard Pointizky (see above).

California, U.S.A., November 12, 0350 GMT (November 11, 1950, Pecific Stenderd Time). Mr. and Mrs. Robert Dickey of San Juan Capistrano (33.50°N, 117.83°W) obeerved e brilliant tire ball during an eventng oi moderate cloud cover. The object first appeared as a very bright tesh along the meridian at a point near the ecliptic, before descending rapidity to the Southeast and disappearing near the visual horizon at about azimuth 120°. The entire event lasted between 3 and 4 e. Varying cloud thicknesses along the flight path caused brightening and derkening. Brightness was most in-lense during the initial tiash, several itmee that of the full

Information contact: Robert Dickey, 8ob Dickey Geolechnical, Inc., 32145 Via Carlos, P.O. Box 894, San Juan Capisi-

Massachusella, U.S.A., November 21, 1414 GMT (0914 Eastern Standard Time). David Folger saw a very bright daylight fireball from Woods Hole, Massachueetts. The object, which lirst oppeared in the northern sky as a single blue-green ball with tell, passed through approximately 10° of erc, descending west to east at en engle of at least 30°.

In midtlight, the bolide broke Into two pieces, both with talls, before disappearing 30°-40° above the horizon. The complete event lested about 1 s. No firebell sounds were heard, but they may have been masked by other loud noisa near the observer.

Information contect: Devid Folgor, Chief, Atlantic-Gull Branch (Marine Geology), U.S. Geological Survey, Woods Hole, MA 02543.

West Texas, U.S.A., September 20, 0220 GMT, (September 19, 2120 Centrel Deylight Time).

Observer/Location: Ed Wafreven, near San Antonio, Tom Green County, wast Texas (31.2°N, 100.7°W), Ronald Schorn and Michael Courtney, near College Stellon, Brazos County, east Texas (30.6°N, 96.3°W).

Flight path: near vertical, ending almost et the horizon.

Duration: 2-3 s. Apperent magnitude: -8 to -10.

Color: yellowish white with red end. R. Schorrt, an astronomer, believed that the velocity was sufficient to rule out men-mede debris failing out of orbit and

that a meteorile tall was possible. Information contect: John Weat, 3502 Old Oaks Drive. Brv-

an. TX 77801

TARLE 4. Observations for South Europe, November 11

		TABLE 4. Obbertation to Country of the						
Observer	Location	Firet Sighting	Last Sighling	Ouration	Magnitude	Color	Size	Trein
	80 km northwest of Klegenfurt, Austrie (47,2°N, 13.6°E)	190° magnetic, 40° above the horizon	210° megnetic	30 e	like a pyro- technicat liera	white, becoming red	1/a of moon	persisted 4 min
-	Venice, Italy (45.4°N, 12.3°E)	NE eky	SW horizon	-	8	euld-eiidw	-	none persieted
Tesi Lucieno	south Marcello, flety (44.05°N, 10.78°E)	NE eky	SW horizon	-	-11 lo - 12	white-blue with green-red	_	none persieted
P. Fepperdue	Viterbo, Italy (42.4°N, 12.1°E)	NNE, 50° altitude	SW horlzon	10 a	-17	orange		wevy trein persisted 2-3 e
-	Rome, Italy (41.9°N, 12.5°E)	~	-	~	-15	red-green with while canter	_	20°-30° long

*Capl. Henisch, F/O Pitiz, F/E Heptner, F/E Hoehe of Lufthensa flight LH 805 (Tel Aviv-Frenkfurt).

New Publications

Applied Water Resource Systems Planning

D. C. Major and R. L. Lenton, Prentice-Hall, Englewood Cliffs, N.J., viii + 248 pp., 1979, \$19.95.

Raviewed by Richard N. Palmer

Design of Wetar Resource Systems, euthored in 1962 by Maass, Hulachmidt, Dortman, Thomes, Marglin, and Fair (Harvard University Presa, Cembridge, Massechusetts) helped to introduce a new perepective in water resource Planning. This seminal text, e product of the Harvard Water rogram, combined economics and systems enalysis with Mors conventional engineering procedures to produce new melhodologies for the evaluation and dealgn of water resource projects. Until this time few precilitioners or loademicians, allowing for sevaral notable axceptions such as Arthur Morgan and Abel Wolman, had taken as careful and comprehensive a view of the process of water resource development and management. Over the years this text has had a algril ficant influence on other water resource plenners and the manner in which they approach problem solving.

In an new text entitled Applia d Water Resource Systems Planning, this influence is cleerly illustrated. Together with 14 coauthore, editore David Major end Roberto Lenton present a successful application of the theory and the techniques suggested by Maass et el. In a study of river basin development in the Rio Colorado in Argentine. The etudy described in the book was conducted in the mid-1970's at the request of the Argentine government by e team of researchers from MIT and government officiale from Argenfine. The research performed three primary purposes: to adopt water resource planning techniquee to Argentina, to train Argentine professionals in their use, end to epply the techniques to the Rio Colorado. The book focuses on the third of these purposes.

The twelve chapters are divided into three parts. Part 1 gives an excellent background to the problem setting, a description of the methodology used, and an overview of the remaining portions of the book, Part 2 describes four mathematical models developed to analyze the problem. Part 3 presents parameter inpute for the model, the results, the interpretations, and the perspectives. Following several of the chapters are appendices that describe in further detail topios presented in the chapters.

for the future development and saquencing of a number of potential hydropower facilities, irrigation eystame, and reservoir projects in the Rio Colorado and aurroundino basins. The researchers approached their problem with two tools advocated by Maaae et al.: mathematical programing end multiobjective economic evaluation. The methodology they developed to solve the problem was a aeriee of mathematical modele, diffaring in purpose and in complexity, that were used sequentially to evaluate potential system configurations. These modele are described in chapters 5, 6, and 7. A mixed integar screening model was used to select potential development at 38 altea in the basin. Hydrologic input conaisied of monthly streemflow data. Potential eyelem configurations generated by the screening model were then tested in one of two almulation models. These simulation models differed in the degree to which the hydrologic eystem was described and the length of time stape used. The time ateps ranged from 4 months to 1 hour increments. (Apparently, the more detailed of the two almulation modele grew to such proportiona that it became very expensive to use end was therefore used sparingly.) Finally, systems that appeared most lavorable were investigated by using a

The problem addrassed in this book wee how beet to plan

sequencing model that optimized investment over e 40-yeer lime horizon. Because of the massive scele of the system, some important compenents were ignored. For instence, oach reservoir was considered as an Independent on tity, and no ettempt was made to derive an optimet operating policy for the sysiom as o whole.

The book is clearly organized and well written throughout. Dospflo the numerous authors, the writing is surprisingly unitorm in style and is highly roadable. Torminelogy and notation, except witere tiolod, ecom to be totally consistent in short, there is no vor the foeling of a disjointed effort which is common imong most books with multiple euthors. Good references et the ond of each chapter ellow the reeder to pursue topics of Interest. The descriptions of the mathemetical models developed in this atudy are exceptionally clear end concise. Of special value ars the discussions that relate the various models end illustrate how the models ere used to complement one another.

In addition to its numerous poaltive attributes, however, the book does contain flews. These flaws ere the most striking when the book is viewed as e potential lext, as is suggested in the introduction. The introductory chapters that discuss mulliobjective plenning and mathematical modeling (chepters 2 and 3) are superficiel and do not lay the necossary foundation for the tochniques thet ere used in the tollowing chapters. Interested readers must aeek the meterial that is referenced to obtain a complete appreciation of these topics. Insufficient emphasis is placed on the process of model development and on model interpretation. The restricted number of approaches and lechniques that are prosented in the book prevents it from being a well rounded infroductory loxibook in water resource systems. At the other oxtremo. If ne models prosonted in the text can no longer be considered alale of the art and are not given in sufficient doloil to allow the book to be used as a basic reference or as nn advanced gradueto loxt.

Dospilo the obove criticisms, Major and Lonton's book would make an excellent supplemental text in an introductory course in water resources planning. Viewed es a case study the book illustrates the valuable process of transforming a complox water resource problem into a system of objectives and constraints that can be quentitatively anelyzed and, ovontually, improve the planning process.

Richard Palmer is with the Department of Civil Engineering, Weter end Air Resources Division, University of Wastungton, Sentite, Washington.

Marine Turbulence

J. C. J. Nihoul, Elsevier, New York, xii + 378 pp., 1980,

Reviewed by John Woods

Thore has long been a conspiracy among fluid dynamicists of an engineering inclination to reserve the word 'lurbulenca' lor a very special type of nonlinaer fluctuations in which three-dimensional vortex stretching drives a cascade of kinelic energy from large scele to small, often with virtually no flux divergence over some portion of the spectrum. The study of such three-dimensionally isotropic (3DI) turbulence has made a major contribution in angineering, but after 75 years of research it is cleer that life is more complicated in the ocean, where mixing is normally domineted by nonlineer fluctuations that are not characterized by three-dimensional vorlex sketching and are all best only two-dimensionelly isotropic (2Di). Rejecting the use of the term lutbulence for auch important oceanic motion, one of tha leading conspiretors insists on using the vivid, it rather rude, term 'lialulence.' This errogani nonsense has prevailed because the engineers have until recently cornered the merket in textbooks and monographs on turbulence.

At last the situation is changing. The development of new tools to meeaure the fluctuations in the motion and sceler concentretions in the ocean has stimulated theoretical end laboratory studies designed to improve our understanding of

the phenomenon of oceen turbulence in its own right, rather than es a minor application of engineering turbulence. Monographs are beginning to emerge.

The volume under review represents e collection of 21 pepers presented at the 11th International Colloquium on ocean hydrodynemics (Liège, May 1979). The Colloquium wes held In essocietion with the second IDOE-IAPSO Symposium on 'Turbulence in the Ocean.' Another book, conteining commigsioned review papera presented at the symposium will be published soon. The two volumea neetly complement each other: The present volume contains papers reporting results of research projects, while the latter will contain brooder reviews. Both contein meterial covering the whole spectral range encountered in the oceen, from millimeters to megameters. Nihoul, in an introductory chapter to Marine Turbulence, Identifies the features that distinguish what we find in the oceen from whet the angineer linds in his/her world. The key factor is that, in the interior of the oceen (i.e., away from the boundary layers), almost sil the turbulent kinetic energy occurs eg motions with lerge Richardson number and email Rossby number. Clessical 3DI turbulence occurs only at scales (~1 m) much smaller than that of atructure in the mean circulation, so there is a spectral gep aeveral decades wide between the input of turbulent kinetic energy and its entry into the 3DI turbulence that can whiak it speedfly to molecular dissipation. Very little energy eucceeds in feeping this gop, with the result that 3DI turbulence occurs only sporadicelly in short-lived bursta in otherwiae leminar flow. The cen-Iral problem of turbulence in the interior of the ocean ia to understand the proceases occurring at high Richardson number/low Rosaby number.

How do the eddles, fronts, and fine atructure refele to each other and to the Roasby and internal buoyency waves propogsting through them? Penchov aummarizes The contribution of clossical 2DI lurbulence theory to this problem, following the epproach of his well-known monograph. One of the themes to emerge from discussione at the Liège meeting was the need to take en integrated view in which ell theae motions, waves included, contribute to the overall budgets of the vartances of momentum, vorticity, tempereture, salinity, etc. It is therefore entirely consistent to find papers by Colin de Verdiera on Rosaby waves end Orlanski end Ceraaoli on Internal waves. There is no contribution in this volume on the addies (perheps because they will be treated extensively in a monograph now being edited by Alen Robinson), but Fedorov reports on a case study designed to illuminate the compliceled phonomenon of front-fine structure interaction. Their takes us up to page 100.

The remaining 278 pages are devoted to papers on the occurrence of 3DI lurbulence in the ocean, meinly in the boundary layers. This is probably a feir belance in terms of effort in the research community, but not, I would have thought, if judged in terms of alther the proportion of tha spectrum covered by 3DI turbulence (about 0.001%) or in terms of prectical applications, eimost eff of which lie at ferge

But, brushing aside thase reservations, let us see what topics are included. The first theme is the cascede of kinatic enargy to molecular disaipation, with contributions from Dilfon and Caldwell (ebatrect only), Oakey and Elliott (documenting the correlation between tha wind speed and dissipation in the wind mixed layer), Osborn (meseurements below the wind mixed layer), and Ozmidov (ditto). There is still some uncertainty about the Interpretetion of the microscale meesurements on which dissipetion estimetes ere based; there ere inconsistencies with measurements of scelar variance spectra (represented here by Gregg and by Gibson). The next theme is the ganeration of 3DI turbulence in the interior of the oceen by aheer instability (field evidence from Belyaev) and double diffusive Inglability (fescinating theoretical expositions by Lumley, and by Placsek and Toomre, in which we see a geophysically important phenomenon simulated on e computer by a numerical model that has no need to parameterize unresolved fluid motion). Neturelly, many contributors are concerned with the turbulance in boundary layars. Revsult d'Allonnes and Ceulliez present a progress

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report on maaaurements from the Bouée Laboraloire, which cen be compared with Dillon and Caldwell data already mentioned. Five papers deal with the bottom boundary layer in the presence of atrong tidal currants. Bowden and Ferguson maasured the vertical profile of shear stress by the eddy correlation method, and for the same area, Wolf eatimated very almillar shear stress values from external data and Swift used an analytical model with tidelly varying turbulent kinetic engrgy to calculate residual currents. Then come two papers on the shear effect on dispersion in tidal flow, by Nihoul, Runfola and Roisin and by Werluzel end Benque. The final contribution, by Veth, describas a new tool—the faaer-Doppiar velocmater—that may make a significant contribution to ocean turbulence observations in the luture.

Conference proceedings tend to be rather patchy, and this is no exception, but Merine Turbulence contains much useful matertal and is recommended not only to those in the busineas, but also to the general oceanographer and, yes, to those who atili believe in the restricted engineering definition of turbulance.

John Woods is director of the Regional Oceanography department, Institut für Meereskunde Kiel, Düsternbrooker Weg. Germany.

Marine Geodesy, vol. 3, nos. 1-4 N. K. Saxena (Ed.), Special issue on interection of Marine Geodesy end Ocean Dynamics, Crana, Russak, New York,

436 pp., 1980, \$48.00. Reviewed by David Welfa

A symposium on the 'Interaction of Martne Geodesy and Ocean Dynamics' was held in Miami, Florida, October 10-13, 1978. The aymposium was sponsored by AGU and six other organizations and consisted of four technical sessions, four concurrent workshops, end a finel plenery workshop. These proceedings contain a summery of the workshops and 15 out of the 28 papers preaented during the technical aessions.

The interactions between merine gaodesy end oceen dynemics considered in thase proceedings separate into the horizontal (a one-way intersciion, the provision of pracise poaltioning by marine geodesists to ocean dynamicists), and the vertical (two-wey interactions in several common-interest aspects of saa auriace halghi). The interactions ere most intimete in the analysis of salelife-borne radar effimetry, which sanaes the inatantaneous sea level, as affected by both the marine geodesists' 'algnai' (the marine geold) and by the oceen dynamicista' signals (variously dua to tides, currenta, storm surges, wind, and etmospheric disfurbances). This intimate interection, in which for each the alguar of the other is often noisa, is well rapresented in the confent of these pro-

The horizontal interaction is considered in two pepars. Halslip reported on the status of radio navigation eystems maintelned by the U.S. Coast Guard. Seeber preaenled results from two Transit Satellite Doppler studies, on the effect ol drilling rig metal decks on height determination, and on the feaeibifliy of precisely tracking moored buoy movements.

The vertical interaction is represented by three groups of papers concerned with ocean circulation, global ocean tides, and the marine geold.

Gatto used remote sensing techniques to determine circulation petterns. Papers by Chew and by Molinari discuss currants in the Florida Straits and in the Caribbean Sea and in Gulf of Mexico, respectively, each touching (inconclusively) on the controverale interaction batween sleric and geodetic

Globel ocean tide (GOT) models are of practical interest in the analysia, for example, of eatelifte sitimetry data, satelifté orbit perturbations, and seabed gravimetry. Zatier traced the complementary developments of GOT models and of pelagic (ocean bottom) tide gaugea, data from which are invaluable. for tasting and tuning GOT models. Three approaches to GOT models wars described by Schwiderski (in two papers) Parke, and Eatae. In the tirst two cases, a theoratical modelwee used to interpolate between tidal data from coastal and laland atations. The M2 constituent obtained by Schwiderski egreed with the Ms constituent from independent pelagic data to within 2 cm in amplitude and 6° in phase. Parke presented maps of some geophysically useful parameters de

rived from modeled M_2 , S_2 , and K_1 constituents. Estes presented a purefy theoretical GOT model (Independent of lafund or pelegic tidal date) end used it in a simulation of the effect of unmodeled ayetematic orbit errors on the problem of extracting ocean tide information from satellite eltimetry.

Determinetion of the marine goold from satellite eltimetry is discussed in four papera. Marsh ahowed that in the short term (treeting see aurface heights owing to dynamic effects gg noise) altimetry is useful in reducing geoid uncerteinties. Brace compared altimetric geofd heights with heights from geveral geopotential coefficient sets and eltimetrically derived meen gravity anomalies with those from marine gravimetry. Torge presented e gravimetric geold for the North See and compared it to one derived from altimetry. For the longer turm, an integraled approach to extracting both goold and dynamic signals from eltimetry is needed. Parra used results from the western North Atlantic to show that grevimetric

geolds can be corrected in local ereas free of permenent geostrophic features end that the study of temporal vertellons n quasi-steedy dynamic feeturea la the most useful contribution of altimetry to ocean dynamics.

GEOS-3 altimetry wes used for ell the altimetric studies reported here. McArthur described the more advanced SEA-SAT-1 eltimeter, together with proposed future improvements. Ironically, the fellure of SEASAT-1 was ennounced during this aymposium.

An introductory paper by the conference cocheirmen end session cheirmen summerizes the workshops, which deelt simost exclusively with the altimetric connection between marine geodesy and ocean dynamics. This is an excellent tutoriel paper on the present and potential uses of this new tool, full of ferment and excitement and occasionelly contradictory. (One workshop concluded that measurele eddles can be studied with existing altimetry; another workshop con-

Hydrogeologist. The State University of New York at Ginghemian invites applications for a permanent position in groundwater hydrology, alarting lall 1981. It is desirable that applicant have teaching and research interests in one or more of the following considerates.

ing: groundweler hydrology, modeling, flow through porous media, and environmental hydrogeology.

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cluded thet altimeter performance must tirst be improved considerably.)

Appearing in a relereed journal, these proceedings are certainly more eccessible, end perhaps more carefully considered in content, then if they had bean produced in a less formel wey. The full flavor of the symposium is elusive, however, since nearly helf of the pepers presented are neither printed nor even listed by title in these proceedings. In particuler, more could have been included on sea level variellons from oceen dynemica effects other then tides. Nevertheless, the pepers here represent a valueble and much needed contribution to our understanding of the interactions between merine geodesy end ocean dynamics and to the dialogue between marine geodesists and ocean dynemicists.

David Wells is with the Department of Surveying Engineering, University of New Brunswick, Fredericton, Censds.

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Oreduals Assistantships/Physics and Actronomy. Grativate research assiste ships and teaching assistintiships in the Ospaniment of Physics and Astronomy of the University of towa are available to well-qualifier students The department has vigoraus research programs in space physics, plasma physics, ncounties, astronomy, astrophysics, glassic physics, elementary particle physics, laser physics, nuclear physics, and solid state physics Assistantshos can begin in June. August, 81 January Please address your inquiry to Ospari ment of Physics and Arthonomy, The University of Iowil, Juwa City, IA 52242

Exploration Depohysis s'University et Okiehome. As partel a 5 year plan of development and expansion, the School of Occlogy and Geophys ics is looking for a person to formthe nucleus ofen exploration geophysics group A Ph O in geophysics is required, and preference will be given to someone qualition, pracessing, and/ar interpretation of seismic data. Present equipment includes a truck-mounted thumper energy source, capable of pensireting a Mometer or more utirock, a portable, 12-channel seism c recording system, grov-meters, magnetomic ters, an electrical resistivity und, m-house mini computers, and forminals is the University's IOM 37G System A geophysical observatory supports is: search in solid earth geophysics, and the exploration grophy sicist would work closely with the tectorics.

chtealth geophysics graup Applications are due February to, 1981. Salary is competitive with industrial standards. Inquiries and accircations should be sent to John Wickham Diec tor. School of Geology and Ocophysics, University of Oklahoma, Marman, OK 73018

The University of Oklahoma does not discriminate on the basis at race ar sex and is an equal apportu-

Synoptic/Dynamic Melecrology.
Description: The Geophysical Indictive and Division of Geosciences, University of Aleska, under applications from qualified accentists for a full-time (12 month) faculty position at the Assistant or Association ate Prates sor level. The euccessful candidate will be expected is prepare and submit research proposels to external exercises and to work cooperatively with ongoing research programs. He she will be elso expected to leach occasional courses in synopticity namic meleorology at the upperdivision and gradu-

atelevels

Qualifications Ph D. in meleciplogy. Research
superience in advanced anelysis and diagnostic studes of global-scale meteorological processes is essential, preferably aver the full height of the etmoophers (0-100 km) Preference will be given to apple cants who can utilize their as pertise in synoplicidy name meleorology to synthesize the results of variaus ongoing research projects in mesoscale and large-scale meteorology, cloud physics, radiation, omy, and space physics into a better und standing et the large-scale melecrology of the North Pacific and polar regions. Teaching experience of

the undergraduate and graduals levels is deskrable Salary Upward to \$34,800 (Ass). Prof) or \$43,300 (Assoc Prof.) per year, dependent upon qualifications and experience

Applications For further information, including recent annual research report, write to Oirector, Geo physical Institute, University of Alaska, Fairbanks, AK99701 Closing data for applications is February

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Sedimentary Patraibglet. The Geology Deperiment of the University of Vermont is seeking a sed memary petrologist for e tenure treck position et the ecoletant professor levet. Research and teaching specializations ahould be in classic sedimentary pa-Irology with potential ancillary interests in pe geology, geomorphalagy, and hydrology. It is ex-pected that the successful candidate will establish a field-oriented research program which includes eupervision al graduato (M.S.) and undergraduate atu-dents. A Ph.O. is required and leaching experience is highly desirable. The Geology Department of the rally at Varmont is a seven member depenmont having an M.S. program and a definite com-Applications will be accepted until April 1, 1661 lates should send e resume and errange lar

three leftors of reference to be sent to John C. Orake Acting Chairmen

Department at Geolagy University at Vermont Burlington, Vermont 05405 The University at Vermont is an equal apportunity-

Feaulty Psettlan. The Copartment of Geology of the University of New Mexico seeks applicants is a position in clay mine re logy, low-temperature geochemistry, carbonate petrology, or economic gest-ogy. The appointment may be at the assistant, each ciate ar full professor level confingent on approval of funding from the university. The individual must be strongly committed to teaching at both the under-graduate and graduate levels. In addition, he or she will be expected to develop a vigorous research p gram in his ar her field of specialty and will be exend Ph.O. levels. The closing dete for application is April 15, 1981. Applicents should send a résumé, undergredusts and graduets transcripts, three letters at reference, and e brist discussion of research inter-sets to Rodney C. Ewing, Chairman, Department of Goology, University of New Mexico, 87131, The University of New Mexico is an equal op

Ocophycles Recearch Ascoclate. Western Observatory at Boston College seeks MS in geo-physics (doctorels work desirable), temillerity with lime and frequency damain analytical techniques and knowledge of FORTRAN programming. Oppor-lunty for independent research stone with assigned responsibilities rotating to New England ealsmic net-work. O elery to \$20,000 dispending an qualifications end excellent benefits. Send letter and resums to Dianno Rogers, Associate Oracter at Personnal, Boston College, 140 Commonwealth Avenus, Chaetnul Hill, MA 02187.

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Drexel University/Atmospherie Scientist. Three tonure track lecully positions are enticipaled starting tell 1961 Applications are solicited from Ph.O.3 with independent research experience in one of the following grass of almospheric science; general direction; climate dynamics with application in setallite meteorology; ournespheric aptics, experi-mental or theoretical with emphasis in mesoscale probing; boundary layer furbulence modeling and etmospheric chemistry modeling. Flenk end salary commensurate with experience. Send resume and references to Or, William W. Erdson, Heed, Depart ment of Physics and Atmospheric Science, Draxel* University, Philedelphia, PA 19104.

Program Menager/Meteorology, Oceanogrephic Services, inc., te seeking qualified ep-plicents for the position of program menager for meleorological studies. Applicants should have en M.S. or Ph.O. in meteorology at atmosphasic sciences, plus experience in the field. A broad general knowledge at air pollution, and an un-derstanding at the air pollution regulatory environ-ment, is helptul. Interested persons should send resume, references, and salery history to Fl. C. Sanks, Oceanographic Services, Inc., 25 Castilian Onive. Goleia, CA S3117.

Research Pleame Physisiet. Barksley Scholers, Inc. has spening in D.C. area. Must be sligible for Ph.O. in plasma physics with specialization in and abstracts presented an theory and numerical simulation at magnetic sheer effects on instability phenomene as a polied to ionos pheric and magnetospheric probleme 1 yr. work experience in the field is required Salary is \$20,000 per yr., 40 hre. per wk. Send resume directly to Berkeley Scholars, Inc., P.O. Box 983, Berkeley, CA 94701.

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The Radar end Optics Division of ERIM requires e Rader Oceenographer, preferebly at the PhD level, to function es head of the Oceanogrephic Meesurements and Analysis Group of the EM Measurements Depertment. Experience as en Oceenogrepher including EM measurements of oceenographic phenomena is required. Experience in the management of research programs is dasirable. Cendidates should heve knowladge of EM remote eensor systems end techniques. The EM Measurements Depertment conducts research progrems to epply EM meesurements tachniques to oceenographic

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ueene College. Position for 1-2 years ee eebbelical replacement starts September 1991. Special-tice requested: geochemicity (organic, environmen-tel, er exploration); exploration geophysica; groundwaler gesingy. A Ph.O. required. Applications should include e.v. and three references. Sand to

H. Speldel, Department of Earth and Environ-mental Sciences, Flushing, NY 11387.
 Queens College is an effirmetive action/equal ap-

Geophysicist/University of South Ocrollne. The University of South Caroline anticipates a new faculty appointment in geaphysics for 1991, subject to adequate legisletive funding. We ere sepa classy interested in inclividuals who have expertise in clary interested in inclividuals who have expertise in the fields at exploration geophysics, salamic interpretation, or solid earth geophysics. This would be a 6-month, tanure track position at the assistant or essociate professor level, beginning August 1961. Some start-up funds are available for imperequipment purchases. The individual who fills this position would join the growing gesphysical component at the Geology Department, which currently amphasizes salamology, regional tectonics, and palarmentations. salamology, regional tectonics, and palarmagnetics, and would develop an aggressive research program

in his er her specielty.

Pieese eand vilse and nemes and phone numbers of three individuals wa may contact for references to Willard S. Moore, Chairman, Seeroh Committee for

Geophysics, University of South Caroline, Columbia, SC 29206. Closing date for this ennouncement is

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Salentiete/Metearstaglefs/Engineers. Ocience Systems and Applications, Inc., (SSAI) hee positisme tar programmere, ensiyete, scientisi end engineers to engage in ecleritic modeling and deta analysis schilles in the aress of: 1. Plasmationospheric physics theoretical simulations & radiative transfer/scettering atudies 4. S etellita dets analysis 5. Weather/climets & severe atoms studies 8. Atmospheric/fluid dynamics 7. Soler and planetery physics and estronamy 8. Computer image processing and systems displays 8. System software/hardware engineering 10. Nuclear lucion/fis-stor and 11. Applied methamerica. These positions involve working with NASA/NOA/NAVY soleniste in metropolitan, Washington, O.C. area. A strong beckground in numerical simulations, and experi ence in working with large scale computers is re-quired for antry level to seniar sciential/engineer po-sitions. SSAI provides a congenial acedemic anvisilions. SBAI provides a congenial academic anvi-ronment, peys liberel fringe benefits and awards bonuses to its employees. Please send your resums with estary hielery and references to Science Sys-tems and Applications Ins., The Aerospace Suilding, Suite 149, 10210 Greenbelt Roed, Seabrook, MO

AGU

Stephen J. Burges—New WRR Editor

The 'lower of Babel syndrome' is the most importent probtem locing water-reaources recearchere, saya Stephen J. Burges, the new coeditor for hydrology end physical, chemical, and biological sciences for Water Resourcea Research (WRR). Burges was appointed to a 4-year term which began November 1. He succeeds R. Allan Freezo.

Specialized resoarch that lacks a senso of connection to other aspects of hydrology characterizes the syndrome. Burges explained. He traces this scallering of intereste back to 1966 with the 'evolution' of the third-generation computer.

To help add coherence to WRR is coverage of hydrology. Burges plans some changes. With the addition of four essociate editors, the breadth of lopics will be increased to include ecological modeling, sedimente, and precipitation. In addition, Durges will ask authore to explain in a paragreph at the beginning of their papere how the research relates to other water-resources problems. Authors also will be requested to identify the status of research described in the paper, and to state cleerly whose work or computer models the research

Burges said that he end coeditor Jared Cohon hope to schieve a better balence of topics and to increase reedership with lhese changes.

Undor Burgee, the asacclate editors will continue to play a major rote in choosing reviewers and in meintaining the high atandarde of WRR; the basic management alyle used by Freezehaabeen found to be effective, in addition, Burges plana to continue to solicit appropriate review articles lo add balance to WRR. Freeze initialed solicitetion of these enticles; Burges and Cohon plan to coordinate their selection of review lopica to bring the two major divisions of WRR closer

Following completion of his Ph.D. In civil engineering at Stenford, Burgee joined the University of Washington faculty in 1970. His undergreduate degrees (physics, mathematics, and civil engineering) were taken at the University of Newcasite, Australia. His research and teaching have focused on the application of systematic approaches to enalysis and deelgn of water-resourcee aystems, with an emphasia on eto-

'At heart I'm e civil engineer,' Burges aald. I atso like ueing a systematic approach to problem solving." Surface water-

etorage reaervoire dominate his interesie. He eeld that he also intriguad by urben water problems, including large-# eystems and flood/drought research. He views atochastic drology as an easantiel tool for the future. We need a met to determine reliability of water systema."

Burges said he looks forward to working closely with hon end maintaining the high standards set by previous 60 tors. Burges noted that they are indebted to Freeze for his outstanding editorial teadership and want to thank him pub

Meetings

Recent Earthquakes Symposium

A cell lor pepers for the symposium 'Reports of Recent Earthquekee' has been made by Ziro Suzuki, aecond vice precident of IASPEI. The eymposium will be held July 22, as a part of IASPEl'a 21st General Assembly, et the University of Weslern Ontario in London, Ontario.

Abstract forma are available from Suzuki at the Geophyalcal Institute, Tohoku Univarsity, Sendel 960, Jepan. Requests for the forms should include author name and address, tenielive paper title, and name, piece, and time of the earthqueke to be reported. Completed abstract forms should be melled by March 1 to A. E. Beck, Department of Geophysics, University of Western Onterlo, London, Onterlo N6A 5B7. Caneda. A copy ahould be sent to Suzuki. Some deedline flexibility will be allowed, but authors should receive permission from the committee. Pepera on earthquekes that occurred during the second helf of 1980 cen be eccepted efter

Time restricte the number of papere on each earthquake to two. Review papers rether than personal studies ere pre-

European Geophysical Meeting

A cell for papers has been issued for the Eighth Annual Europeen Geophysical Society Meeting, scheduled for August 24-29 in Uppseta, Sweden. Abetracis-one original and two copies-should be sent to K. M. Storetvedt, Cheirman Progrem Committee, institute of Geophysics, University of Bergen, Allegt. 70, N-5014 Bergen University, Norwey. Deadline for receipt of abstracts is June 1.

in addition to 13 symposia, one workshop, and en excursion to a mateor-impact structure, there will be two society lectures. H. Alfvén of Stockholm will apeak on plasmas in the cosmos and the taboratory, and H. Morttz of Graz will give a lecture entitled 'The Figure of the Earth.'

Applications for travel awards for young scientists are due March 3t. Forms can be obtained from the EGS General Secretary, 6 Carllon House Terrace, London SW1Y 5AG.

More information about the meeting, which will run elmulteneously with the Uppseta Caledonide Symposium, can be provided by the Local Organizing Committee, C.-E. Lund. Chalman, 80x 558, S-75122, Uppsala, Sweden.

Hydrometeorology Session

The 15th Annual Congrese end Annual Maeting of the Canadian Meleorological and Oceanographic Society (CMOS) will be held at the University of Saskaichewan, Saskatoon, Saskatchewan, on May 27-29. The focus of the Congress will be hydromeleorology; acheduled ere sessions on waves and tidas, drought management, the Canadian Climate Program, environmental asaessment, stretospheric dynamics, temole sensing, and polluted precipitation. In addition, aesstons on eir pollution meteorology, eponaored by a CMOS special interest group, will be conducted concurrently.

Authors wishing to present pepers at the congrees or at the special eir-pollution sessions should aubmit abstracts of fewar than 300 words by February 1. Address all correspondenos to Barry Goodison, Hydrometeorology Division, Atmospheric Environment Service, 4905 Dufferin Sfreel, Downaview, Onlario M3H 5T4 (call 418-867-4914), Authors should indicate in which seesion they wish to be included. \$3

Cafifornia Mining Association

California's minerale industry and its impact on the nation will be the focus of the 1981 Calliomia Mining Association Annual Meeting to San Diego, March 5 -7.

Technical aspacts of California mining and political probisms which concern the industry will be emphasized. More than 200 representatives from major industrial mining itima in the elate are expected to attend.

Ragistrellon (a \$75 per pereon; spouse registration is free. For additional information contact the association at P.O. Box 3, Jackson, California 95642, or call (209) 223-1129. \$\$

Geodetic Networks and Computations

An inlemational symposium on geodetic networks and computations will be held in Munich, August 31 to September 5. The symposium, aponsorad by the International Associadon of Geodesy, will take place at the Bavarian Academy of

Topics to be covered at the symposium include objectives of geodelic networks, slatue reports, and future plans; optimal dealgn of geodelic networks; network analysis modela; space techniques for terrestriel networke; combination of horizonlet, vertical, and gravity networke; and computational Probleme in claselcal and nonclaselcal adjustment models. For additional information and registration forms, write to Dautsche Geodatleche Kommission, Bayerischen Akedemie er Wissenachaften, Maretalipiatz 6, D-8000 Munchen 22. 88

Snow Chemistry: Cali for Papers.

Acell for papers hae been lasted for the 36th Eastern Now Conference, scheduled for June 4-5 in Syracuse, New York. A special seed on will be held on anowpack and anow-

Authors wishing to present a paper ehould submit an ab-lifect before February 15 to Barry E. Goodlson, Program Chairman Almospheric Envi-Chairman, Hydrometeorology Division, Atmospheric Envitormeni Service, 4905 Dufferin Street, Downeview, Ontario 16H 5T4, Canada (call 416-667-4914). 38

IASPEI Workshop: Seismic Modeling of Laterally Varying Structures

During the pest 10 yeers, significant progress has been made in the methods of collection and analysis of saismic reliection end refrection date. This progress has led to the development of new models for the structure and composition of the earth's crust, based on sophisticated energies of numerous profiles in many ereas of geologic importance. The third triennual meeting of the IASPEI (International Assoclation of Seismology and Physics of the Earth'e Interior) Commission of Controlled Source Seismology was convened in Park City, Uteh, on August 11-17, 1980, to bring together selsmologists and geologists to explore and assess the progress of controlled source techniques (controlled cources include explosions, eir guns, and Vibrosels-type sources), and to eveluete ite significance In terms of current models of the selamic velocity structure and composition of the crust and upper mentle. Particular atlention was paid to the progress and probleme in the modeling of two- and three-dimensional structures.

The Park City location of the conference was ideal for the contemplation of the complex structures that we are presently ettempting to model. The effects on the crust of the ection of tectonic forces were essily discernible from the etr dur-Ing the epproach to the Salt Lake City elrort, and on the ground during the field trip into the Wesetch Mounteins led by R. B. Smith of the University of Ulah.

Two end one helf days of the 5-day conference were used to discuss different interpretations of the selsmic retraction data coffacted in Seudi Arabte by the U.S. Gaological Survey In 1978 [Bisnk et al., 1979; Lamson end Leone, 1979]. The format of this portion of the meeting was unlike most other scientific workshops. The complete refrection date set had been distributed to the perticipants well in advence of the meeting, giving each seismologist (or team of setsmologists) time to thoughtfully analyze the seme date. The use of a common deta base sllowed for a kind of In-depth examination of Issues of Interpretation that is not possible in Iradillonal workshops which are based on diverse dele sele.

A discussion of the geologic framawork of Saudi Arabis and the southeastern Red Sea waa particularly pertinent because all proper selemic interpretations are constrained by the known surface geology. (The geologic map of Seudi Arabia was distributed to all participants along with the aelsmic deta set.) The discussions began with an introduction to the geologic problems of Saudi Arabia by H. R. Blank and an outline of the planning and goals of the 900-km-long refraction profile (see the figure, pert A) by M. Q. Assad. This was followed by a series of epackers who explained their leam'a Interpretation of the date and the methods that they used to derive velocity-depth structures. In the course of these presentations it became evident that the main source of dilferencea in the final modela is the phese correlation of the data. The term 'phase correlation' refers to the process of identitying, within a aeismic record section, those arrivals which refract or retlect from the same feature (or portion) of the crustal or mentile velocity structure. For example, the pheae P* refracta in the middle cruat, while PmP reflects from the M discontinuity. A knowledge of the expected amplitude end frequency of a particular phase, based on experience and theoretical considerationa, fecilitates its correlation in the record section, but the complexity of the typically observed wave field leads to e degree of subjectivity in the interpretation of the phases. Given identical phase correlations, different methods of travel time end emplitude energies of these phases witl produce neerly the same result. Conversely, different correlations will result in merkedly divergent models. These points can be appreciated from the comparlson of the models of the Arabian ahleid (eee figure, pert

B) to those of the Red Sea-continent transition (see figure, part C). For the most part, the teems of interpreters agreed on the phase correlation of the profiles between shot points t and 5 (see tigure), and the resultant modele reflect the agreement. However, the correlations and interpretations of the date crossing the Red See-continent transition were diverse, which ultimately led to quite different models for that region (eee figure, part C).

A few highlights of the meeting on the interpretation of the Saudi Arabien refraction data are summarized below. These lew impressions do not completely characterize the great emount of interpretive exili brought to bear on the dete and the livety and constructive discussion that ensued.

(1) The upper crusi (21 km thick) of the shield has e nesrsurface velocity of 6.1 km/e and, in most regions, a positive velocity gredient of 0.01-0.02 km/s/km. Low velocity zones may be present in some regions.

(2) The lower crust (19 km thick) of the ehfeld is seperated from the upper crust by a eelsmic discontinuity or smooth transition of 0.2-0.4 km/s. The average velocity of the lower crust is about 6.7 km/s.

(3) The M discontinuity le probebty a transition zone 2-5 km thick end occurs et a nearly constant depth of about 40 km. Uppermost mantle vetocity is 8.0-8.1 km/s, and there is evidence for fine etructure within the lithosphere.

(4) The structure of the Red See-continent transition remains uncertain with the currently available data. The renge of proposed models is indicated in the tigure, part C. improved models would result from the recommendations be-

A general consensus was reached on recommendations for tuture eeismic refrection and rellection work in erees with strong lateral velocity heterogeneous structure, such es the Red Sea-continent trensition in western Saudi Arabla:

(1) Perellel-to-structure refraction profiles are needed in regions of complex structure. In the present case, retraction profiles are needed along the coesial platn and in the Red

(2) Perpendicular-lo-structure profiles must be densely recorded and should include considerable deta redundancy.

(3) Critically placed seismic reflection profiles would help resolve delails in the areas of greatest structural complexity. in the present case, reflection profiles crossing the Hijaz Azir Escarpment (see figure, pert A) would help in understanding the structure acroes lhis rift boundary.

The commission officers were (cheirmen) S. Muellar, ETH-Zurich, Switzerland, and (secretary) J. Ansorge, ETH-Zurich. Switzerland. The local organizers were D. P. Hill, Menlo Park, California; J. A. Orcutt, La Jolle, California; and R. B. Smith, Salt Lake City, Utah.

Acknowledgments

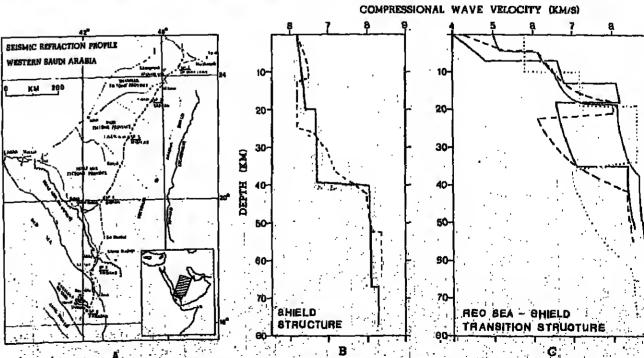
Financial support for the workshop was provided by the Office of Naval Research end the U.S. Geological Survey. We thank the Directorele Ganarat of Minerel Resources, Saudi Arabta, for permission to use the seismic rafraction data for this workshop.

References

Glank, H. R., J. H. Healy, J. Rollar, R. Lamson, F. Fisher, R. McCleam, and S. Alien, Seismic retraction profits, Kingdom of Saudi Arebia: Flaid operelions, instrumentation, and initial results, Rep. 259, 49 pp., Saudi Arabian Mission Proj., U.S. Geol. Surv.,

Lamson, R., and L. Laona, Saudt Arabia salamic refraction profile: Data eet, Volume I and II, Geol. Surv. Open Fila Rep. (U.S.)

This meeting report was prepared by Walter D. Mooney, USGS. Menio Park, Celifornie.



(A) Location map, USGS-conducted seismic refraction investigation of western Saudi Arabia and the southeastam Red Sea: shot (A) Location map, uous-conquete seisme regarded investigation of wedget of the action map counsels and the southeast map and the season points (SP), profile line (dashed line), and tectoric provinces. (B) P wave velocity structure of the Arabian Shield, presented by workshop participents; shaded region outlines the range of velocities of most models, solid line is a typical example, while dashed line is an alternative model. (C) Four P wave velocity structures for the Red Sea-Shield transition; the data were sparse in this laterally inhomogeneous region, making possible these radically different interpretations.

AGU Spring Meeting May 25-29

Call for Papers

Abstracts must be received at the AGU office by 5 P.M. on March 4 to be on time. Late abstracts (1) may be summarily rejected by program chairman, (2) may not be published in advance of the meeting, and (3) if accepted, will be charged a \$25 late fee in addition to the regular publication charge.

General Regulations

Abstracts may be rejected without consideration of their content il they have not been received by the desdline or are not in the proper format. Abstracts may also be rejected if they contein material outside the scope of AGU activilles or becsuse thay contain material already published or presentod elsewhere. ONLY ONE CONTRIBUTED PAPER BY THE SAME FIRST AUTHOR WILL BE CONSIDERED for presenletion; additional papers (unlass invited) will be automatically

Only AGU members may eubmit on ebstract. The abstract of a nonmomber must be accompanied by a membership application form (with payment), or it must be sponsored by an

A publication charge of \$40.00 for each contributed ebstract will be involced (\$20.00 it the lirst author is a student member and it the appropriate notation is made on the abstroct when submitted.) Both invited end contributed papers are subject to the publication charge unless specifically walvad in writing. To rapeol, the ebstract must be received at AGU by Morch 4 to svoldon additional \$25.00 charge. If e revised version of an abstract must be published, il will also be assessed a \$25.00 chorgo.

Authors will be notified by mail in late April of the status of lhoir papers. Rocolpt of oil papors will be acknowledged. Ton rninulos is normally allowed for the presentation of osch contributed paper, and only 2" x 2" (35-mm) elide projectors and viewgraphs are usuelly ovailable as standard equipmont at the meating. All other equipment is sysitable st cost plus a \$10.00 billing charge it we have to invoice.

Instructions for Preparing Meeting Abstracts

The abstract page is divided into two parts: the abstract itself and the submitted information. Follow the instructions for both caratully. Plaase use a carbon ribbon to type the materist, and do not exceed the maximum dimonsions of the abstract of 10.4 cm by 20 cm. Abstracts that exceed the noted size limitstions will be trimmed to conform to the proper dimensions.

The meating program witl be prepared by pholographing the abstracts exactly as they are received. Use the model abstract to prepare the tinal version. Submission of an abstract for en AGU meeting is presumed to carry with it permission for AGU to raproduce the abstract in all editions of Eos and in the programs and reports relating to the meating: it is elso presumed to permit the trae copying of those papers. Allhough Eos Is a copyrighted journal, authors are not requested to transfer copyright; copyright, where it exists, will be reserved by the authors.

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Numbers refer to the Items in the submittal block on the sample

- 1. Title of meeting.
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- 3. Corresponding address.—Giva complete address and phone number of euthor to whom all correspondence (acknowledgment and acceptance latters) should be sent. Abbreviato as much ae possible.
- 4. Section of AGU to which abstract is submitted. -- Use letter abbraviatione of one of the following: G (Geodesy), GP (Geomagnatism and Paleomagnetism), H (Hydrology), M (Melecrology), O (Oceanography), P (Pisnetology), S (Seismology), SA (Aeronomy), SM (Megnetoapheric Physics), SC (Cosmic Rays), SS (Solar and Interplanetary Physics) ics). T (Tectonophysics), VGP (Volcanology, Geochemistry, and Petrology), U (Union).
- 5. Type title of special session (if any) to which submitted le
- 6. Indicate your praference for a particular kind of presentation by one of the following letters: O for orat, P for poster. The chairman may assign your paper to either of these types of presentation in order to fit his program pien.

Sample Abstract

TECHNIQUE FOR THE PREPARATION OF ABSTRACTS

F. R. S. T. Author (School of Oceanography Hydro University, Watertown, Mass. 02172) S. C. N. D. Author (USGS, Woods Hole, Mass. 02543)

(Sponsor: I. C. Alvin)

Follow this example in typing the abstract. The printing plates will be prepared by photographing the abstracts exactly as they ore received, excapt that abstracts exceeding the maximum length (20 cm) or width (10.4 cm) will be cut to conform.

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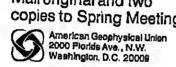
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and are prescubly associated with an open (recommendiated index of the variety livid and point the journer
recordings also display that learners that have
been cheatered at the variet latif end rote
than in the "group" sense at the outer edge of
the cagnetopause display that learner of points
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Spice-rafi!
I. cophys. Sev., Glue, Paper 80x1811

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5751 PLASTA INCOMINICANA SIDE BANDS IN THE

J. Geophys. Res., Blue, Paper 80A1345

CENTRATION OF UNISTER-MODE SIGE BANDS IN THE MACHETOSPHERE

G. G. Park (Radiosrisoca Laboratory, Staniord Diversity, Staniord, Ca. 94005, U. S. A.)

Will transitive appendents ronducted at Siple, Antertrics (1 * 4) show ther long [7] sac) keydown signess injected late the augmencembers often gasorara side banda as a result of non-linear large area of the banda as a result of non-linear large area with senggele particles. The spactral characterfelice of observed side bands sroquits waried and complem. The side band iraquety spacing wates from -7 Ms to 100 Ms, but it bases no misple relationship to the carrier suplitude, in sharp contreer for the pradictions of some theories. The side band amplitude is usually 10 dB or core balow the carrier applitude, but scorrings it can accent the carrier usually 10 dB or norm below the carrier appli-tude, but sometican it can extend the carrier socializate and also trigger unincione. Publiple side bands are siten observed, and that its-quarcy separations from the carrier may or ray not be harmonically calared. Side bend nepli-tudes may be symmetrical or espanetical about the carrier. In the asymmetries came, it is studied to upper side bend that is stronger. Various side band generation streamines are dis-cussed in the light of these new amportmental data. 1. Grophyr. hea., Sige, Paper 804820

STIL Pfasma Instabilities

BBETSVATIONS OF QUASIPERIOPIC FLUE VARIATIONS OF

BBETSVATIONS ASS SIRCTSONS ASSOCIATED WITH PC 5

CECHAGNATIC PH SATIONS

C. Exames 'Hearlianth'-intelled für Aeronomis,
D-late Retissburg-inden J. PED. A. Korth.

LA. Yajec, E. Wilton, A.V. Gutavich and C. Anata

Simultaemost quasiper bodic variations of sfer
terms (8, "22 bst), ione (E, "27 hev), and the

geologistic lials in the V. 9 period range were

cheaved emboard ibs geoststicmery satalities

clos-2. 94 assocs occurred between August 1978

and july 1979. You types of sennes could be

distinguished. During the livet type alsotroms

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ison flue maxims and vice verses. The in-phase

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predictions of the doift mirror instability theory. In rates of this theory the two different types of quesipariodic events too be regarded as the result of different temporare of the efertions on the disturbance conditions excued soon and dunk. The drift mirror lestability is essected with drifting energetic proton busshes that the drift of the energy is the proton busshes that agent and it is a second and i

STAN Plasma socion, convection, or circulation POSITIVE ECR Chapter Attracts to TIR WINDLE WARMINGSPREAD OF JUPITEP P. L. Moment, Jr., J. W. Beloher, and H. B. Bridge. Department of Physics and Conter for Space Peaceach. Cachridge. PA 021391 we consider the positive fon data garbered by the Voyager Plasma Science experiment in the middle magnetosphere of Jupiter. The experiment measured positive tons with energies per charge between 10% and 5950%. The observations are analyzed to obtain the mass and harge donaities, velocity components, and respectures of the few energy plasma popularion. The reduced data set is discussed in the rontest of the outstanding questions concerning this plasma popularion and its dynamics. We find that on the dayalde, there exists a transcente to highly supermeid positive ion population which rends to some existability but does not rigidally cororate with the plaset. These fone provide the inertia of the segmetospheric plasma inside of -40 Rg. The seas donaity is everywhere dominated by heavy ions sed the mass density gradient is consistent with outward diffusion from the 10 plasma tone via fias tute interchange. The lone tond to be concentrated in a plasma shaper which is easted at the sheer is relatively cool (-20 eVI compared to plasma at higher segments lectiudes [2100 eVI. in addition to the assumption in the current sheet the facted from the current sheet on the dayalde and toward the current sheet on the dayalde in the ward the current sheet on the dayalde in the plasma sheet is provided to the nightside. This dynamic expansion and contraction of the plasma sheet is provided and contraction of the plasma sheet is provided.

J. Geophya. Res., Flus, Paper 80A1602

S760 Plasma motion, convecting or circulation QUASTITATIVE SINGLATION Of A MACHATRAPHERIC SUBSTORM, 3. PLASMASPINER ELECTRIC FIELDS AND EVOLUTION OF THE PLASMASPINER ELECTRIC FIELDS AND EVOLUTION OF THE PLASMASPINER 8. V. Epiro Pepartmont of Space Physics and Astronomy, Rice University, Mouston, TX 770011 13. Harsl, R. A. Voll and C. W. Belf.

Ramulta of the Sice University substorm simulation have been used to investigate the ponerration of substorm-assoriated electric fields into the plasmasphore. Heart Ag, in the equatorial pfama, our time-dependent electric fields under in present the electric field model is characterized by eastward components for the dusting individual before dusk, the model predicts assistant electric field components throughout the device ractor. The characteristic radial component is directed inward at all local times accept for a small region just after dawn. Home regular acceptance inversity with avoilable whistlar and funcharent gratter maker measurements of the device for plana first tubes from that the dawn. Home regular for plana first tubes from that the dawn is the planafeure invited the short-rest would not the planafeure diring the substorm-like event of 19 September 1976. We find that native titismentary dusk within hours of substorm onest. These islinity repealings to the pineamaphers subsequently drift rapidly from the dusk sector toward the device eagnetonums.

drill rapidly from the number serial closes the deptine asgnatopause. Investigation of the largo-scale time-dependets flow of piness in the evening sector indicates that come indicates delight sestuard past the dust terrinator caverage their conform between dust and indicates and begin to driff; westward seems dust will ridingly and begin to driff; westward seems dust. Such time desendant changes in flow trajectories bay he related to the formation of f-region ionization croughs. J. Geophys. Rac., Sinc. Paper SCA1820

2760 Please motion, convection or circulation QUANTIVATIVE SIMULATION BY A REQUETOSPHERIC BUSTORM, 2. COMPARISON WITH OBSERVATIONS M. Herel (Department of Space Physics and Astronomy, Rice University, Houston, TX 77001) E. A. Welf, R. W. Spira, C.-K. Chen, W. J. Burks, Y. I. Mich and M. Saiddy Several results of the computer simulation of the behasior of the inner magnetosphere during the substorm-type event of 19 September 1976 are discassed in detail.

The substore-type event of 19 September 1976 are discassed in detail.

The sodel predicts a modear ring-currant injection, in to 1 = 0, with total strength that 10 compareble to the strength activated from the observed decrease in Ser. For the gassynchronous-orbit region on the dnek side, the model predicts e characteristic energy disparation often observed by fellumin and collaboraterat anargatic ions arrive first efter embators onest, followed by issue suergeric ions.

The compared electric fields compare satisfactorily with electric limits measured from 37-7, although there are detailed differences. Three general leatures on which the model and observations are in good agreement ever (1) the magnitude and direction of the high-latitude electric fields (2) the degree to which the low-latitude ignomphers to ableded from the high-latitude

tuda and direation of the high-latirude electric field (2) the degree to which the low-lective ionosphere to shelded from the high-latitude cooreacton electric field on the dush side is elenificated to the state the polarest electric field on the dush side is elenificated electric field on the dush side is elenificated electric field on the average, then the squaterward electric field on the second concerns of rapid flow agestorward of the superal zone, involving an electric field of sore than flow with the reput of the superal zone, involving an electric field of sore than flow with the reput of the second in the predicted section flow was accurately predicted by the sodal.

The predicted sect-wer segment perturbations due to region-7 Sitheland currents agree satisfactorify with 53-2 observations with remard for direction, rotal asgnitude and general location, but there is an important general discrepancy; in most cases, the actual Birledand turrents were discribing over a vider range of intitude than the code with the contract of the contract is bounded on its equatorward and polarurd elides by regions of downward corrent.

The codel provider a useful proture of the covaril magnatosphere-lonosphera current system. It also suggests that the observed aspmetry in the change of the barlonest angents fitted at low-letting ground stations during the such leaves of the inner-segments opher for ing current and the associated region-2 Birkeland current. Region-1 Sirkeland currents. Region-1 Sirkeland currents. Region-1 Sirkeland currents. Region-1 Sirkeland currents.

ol low-leftude SN, while operhead SNI currents agent to play a leaser role.

The model indicates that the total Joula heating during the awaot is - 3 times the locrace in ring-certain anergy, a result that is for appearant contradiction to some previous emilweten. Agencial, but highly approximate, analytic arguest is presented in support of this result of the simulation. Some misple formulas

the namemberical shape of the bacogen inclusions. Six parameters are needed to quantify the model fully: two elastic codell for the heat rot, two for the inclusions, the hearogen content, and the for the inclusions, the kerogen contact, and the inclusion sepect ratin. The model is compared to a set of statically measured slastic model. Good aprecent with lean oil abis date was found. However, tone systematic differences appear in comparison with moduli measurements. suted ultresomirally. Coophysics. Vol. 46, No.2

6110 Alesthciry, fracture, and flow PREQUENT DEPENDANCY OF SEISHE DISSIPATION IN SATURATED ROCKS.

B. R. Tittmann (Notivell International Science Center, Thousand Osks, California 91600)

H. Redier, V. A. Clark, L. A. Malbarg, and T. W. Spencur.

Heasuremers of the specific dissipation factor, Orl, bave been made in saturated rork as a luntion of silentive pressure. The measurements of version of silentive pressure. The measurements were need at two different frequencies, one in the image of 108 to 250 Hz and the other in the range of 7 to 9 MHz, sating the resonant bar marhod. In acturered took, Qri is lower at the lower trequency, and the difference between the value of Qri cassured at the high and low irequencies decreases as elfective pressure increases. At effective pressures grower than 200 bare, the Art offective pressures grower than 200 bare, the approaches that oldry Berse mondations measured at 7 kHz. Iscienci dissipartion, esturated cock, (requency test, lett.) Paper 8011264 (requency dependence)

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1. Copphys. Rus., Blug, Poper BQ/1816

5760 Plasta ration, convection, or circulation 10% STERMS is THE NAMES INTAIL.

T. N. Sharp, B. L. Cart. U. A. Paterson, and E. G. Shelley (Lockneed Paio Allo Sessarch Laboratory, MSI Hanover Street, Paio Allo, California)

Jon rate spectromater observations of low temperature electing plasmas in the earth's capnetriali are reported. Heasurements in the energy per charge roast 0 £/4 § 17 levie wore wade at Mancharge roast 0 £/4 § 17 levie wore wade at Mancharge roast 0 £/4 § 17 levie wore wade at Mancharge for radial distances 2 12 pc from the CFE-1 specerair. Jon streams of a claim wind origin in the masselectal boundary lever and of immunistic wrigin in the toil inheas and plasma shoot are characteristics of the streams of immunistic or information to the control levies in the control and that the immediate in a minificant contributed of ion streams of immunished control there.

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SING Plants mation, convertion, or circulation PLACEA CASSIVATIONS OF THE ALPVICE WAVE

GUVENIED BY to J. W. Beirherickpartment of Physics and Conto.

J. M. Beirheribspertuent of Physics and Contor for Space Remerchi MIT, Cambridge, MA 02132 6. Courte (Non-Plumin-Institut for Astronici Emilenburg-Lindau J. U. Germany, J. D. Sullivan, idepartment of Physics and Cantor for Space Remerchi MIT, Cambridge, Mn. K. M. Atuma Naborarory for Extraturnostrial Inysics (Godard Space Plight Contur, Grandwit, MD 2077).

be how extained the changes is positive lost the changest ty the Voyages i Planus Ecloned instrument tear the icellus tube. The measure-chats are consistent with the detection of Volcity purturbations in the magnetospheric lies due to the southwardly propagating allows was observed by for

How dum to the southwardly propagating altwhowave generated by for.
This conclusion is based on a theoretical
similation of the derector response woing: Its
be placed densities and temperatures derived
from the inhound observations at the for in-shellilif the respect Pield Fortunestions cheervad
curboard meat in, and (1) the velocity perturlations derived theoretically from these magmeric tiris persubations, using the standard
Altwin saw erfations. This simulation produce
fautits which are qualitatively in agreement
with the observations. In perclaular, the
George disease and yeonal standard with a
bouthwardly propagating Alfwin wave.
I. Geophyt. Bes., Blue, Pepst 80A1542

3710 Short-period fless than 1 day) variations of capathe 71413 divided that a REALYSTIC MAGNETO-FRENIC MAGNETO

recopied trasvarae wave squartines have been solved in a cagneric dispoie field whereas only on approximate sofutines have been used in more trasval graveries. He have developed a solution of the droupled quotions to a general magnetic lioid geometry including the effects of density and case composition. The aim of this paper is in incluse and examine the affect on eigenfrewards of out the field geometry by keeping density constant along aif field lines. He review the diwral resistions in wave parted predicted on the ground and in space by using the ferent dison-Filter magnetospheric magnetic field and in our solution. For example, on the ferent dison-Filter magnetospheric magnetic field in a factor of 7. At 6.6 Pg. where the dipolation factor of 7. At 6.6 Pg. where the dipolation after the capter, there is negligible distrant variation in field. Significant diurnel variational plant in space occur only at distances \$10 Pg. Pooledge of the field geometry in whom to be in space occur only at distances \$10 Pg. Pooledge of the field geometry in whom to be in space from pulseline observations. We discuss the impact of our results in interpretation of superiors the space for our results in interpretation of superiors distance in interpretation of the superiors of our results in interpretation of the superiors distance in the superiors.

Physical Properties of

Sife Risettery, (tacture, and flow ACMSCRITE HOPE FOR THE AMISOTROPIC ELASTIC NORTH OF LEWS OIL STALE Ibn B. Rundle (Swigdon 554), Sandia istoratoriae, Albertuse, He 7/183) Fart W. Schuler A sudal to predict the auteotropic electic mod-of a homogeneous allipsocidal location to a host turis to used as the bests for computing the de-formation of the composite. Both inpulsations and the host tack, are presumed to be separately iso-

Rocks

610 Elasticity, frecture, and flow PROPAGATING EPISODIC CREEP AND THE ASSISTHE SIP REMAYOR OF THE CALAYERS FAULT NORTH OF MOLLISTER, CALIFORNIA AT CONTROL OF Earlinguate Studies, U.S. Geological Survey, 345 Middletield Road, Menio Path, CA 94025, USA) and G. C. P.

Moad, menio Pact, tx 900.9, own and to ring
A detailed kinemalic sludy of lawit silp occurring from the surface to a depth of about 7
I'm at the Calovaras fault north of Hollister wat
conducted ducite the tumber of 1917. The observations coincided with a period of prapagatteg apisodic fault creep ectivity tensed along
the fault trace. Data used in the investigation
consist of creepmeter records, near-fetd scrainmeter observations, and high-resolution geodatic
measurements, all collected contemporaments by
over a petiod of four months. Seletibed descriptions and analyses of the creepmeter and geodatic
data have been presented alsewhere. The nearfield sirain measurements ore here reported in
detail and their harlysis dears upon the previous two data sets for support. The tirainmeter
observations are may sensitive to silp occurous two dele sets for support. The tiral number observations are most sensitive to sile occurring in the upper two bilomefers, hacto the emphasis of the paper is placed upon the role of propagating episodic creep in the broad-scale behavior of the fault.

propagating episodic creep in the observation propagating episodic creep in the observation of the fault.

The results suggest that propagating episodic fault crace os sensed along the lault trace is confined to the unter tilometer or to of the state and represents the response of the surface layers to a longer-leam form of spisodic acciding the occurring below. The mean (on of the advancing cupture frost within the upper injugate in usions lely the same as that indicated by record from the surface creepmaters. Evidence is presented, however, which suggests that propagating treep over; may not always breck the turface, and may propagate at validities much slower date at amplitudes significantly larger than those generally observed at the surface. (Fault greep, need field attent, slip propagation).

ALLO Flaggiffers, fracture, and the ULIFASORIC VELOCITIES IN CRETACINES CRAIFS FOR THE ULIFASORIC VELOCITIES IN CRETACINES CRAIFS FOR THE ULIFASORIC VELOCITIES IN CRETACINES CRAIFS FOR THE ULIFASORIC VELOCITIES IN CREAT Hilliston BASIN
Important of Gentage and G Flatba pressure for set, undished sapice and Crasesous shales from depths of 1200 and 5000 ft in the Willioton basis. North Dateia. These whise behave as trenswirsely lacropic situate radius, the plane of circufer Agrorry coinciding with the bedding place. For compressions in the bedding place for propagation in the bedding place than at right angles in it, and the salestropy is greater for the 5000-ft while, for shear waves, the Maray expendicular to bedding and the 35-wave parallel to hedding propagate with the same speed which is about 25 percent fower than ther for the lawrest parallel to bedding, fo general, compressional and shear volcatities are higher for the indurated 5000-ft shele then for the triable 1200-ft shale. All valorities increase with increasior contining pressure to 4 bar. The 200-ft shale while is fact to since tonesistant for the 5000-ft shele. Many features of the dependence of volcity on pressure can be expletted by consideration of affective pressure and the dependence of volcity on pressure can be expletted by consideration of affective pressure and the degradous water saturation, for both shales, faboratory compressional wave valories are on expense 10 percent lights than log-derived valorities. The discrepancy cannot be explained requiredly, but lively contributing factors are sampling blas, valority disparaion, and forwardion desage to size.

blid Electricity, fracture and flow DYNAMIC AND STATIC MODUL!

C. H. Cheng [Massinchusetts Institute of Technology, Cambridge, Hansschusetts 02119] and Gavid H. Johnston

Static and dynamic bulk moduli [Vg and Vg] are massured as continuous functions of pressure from ason to 1-3 kfjobers for rwn sendstones, a tuff, Linewrote, granirs and oil abels. Sensure for the sandstones and granirs are in good agreement with previously reported dara with Xg/Kq varying with previously reported dara with Xg/Kq varying The sandstones and gradic are to good agreement with practicusty reported dera with K_k/K_k varying brom show 0,5 or ottospheric prossure to close to unity ar prossures 2 vilobers and above. Yor rocks behaving olastically under atelic loading, the K_k/K_k tatio is invitedly related to the inferocrack density. For the idensity of the idensity, the idensity of the cold shape, in which lew bistrocracks selet, K_k/K_k occurses the idensity constant value of about 0.7.

Geoblys, Eng., Latt., Paper 801.584 Gnephys, Era. Latt., Paper 501,1584

MONIMERATY FN ROCK: FYIBERGE FROM EARTH TIDES MONIMERATY FN ROCK: FYIBERGE FROM EARTH TIDES Duncan Carr Agnew (GIEES, Campus Sex 449, University of Colorston Boulder, CO 80309)

The Farth in sinuscidally sergested by Eldni forcan if the erress-strein relation for both in annimer energy should appear in an arristiples of those of the larger illai lines. An assailpation of those of the segmenton which are musiciples tion of the signois to be separated for different tion of the signois to be separated for different nonlinear dolormation idea shows that for a non-nonlinear depends which are that for a non-time response without diemipation; the largest ingesting dissipation is assail and the secondary the secondary. The alas of the signal interest the frequency. The alas of the signal in these this frequency. The alas of the signal in these this frequency is a secondary to the dissipation affects the particular which dissipation structs the particular to response being seasoned. For measurements of response, being seasoned throughout the Earth in a shelpal signal depands on whether dissipatine in the seasoned to be present throughout the Earth in the seasoned to be present throughout the Earth in the seasoned to be present throughout the Earth in the seasoned to the seasoned in the seasoned in the seasoned to the seasoned in the seasoned in

explained by leading from nonlitear value tides to the Gull of California and the Pacific Geam; the residual sentineer ride is by do less than the H₂ tide. The signal at three rices the H₂ inquency is copyrible with a lineer model or with nonlinear hysteresis loops provided that nonlinear dissipation occurs rhroughout the farth. Nonlinear dissipation is the rocks need the straingster would produce a farger signal rhoule agent. . Gaophys. Bog., 7e4, Paper SOB1314

All injustions of state Equations of state of state of state of state of cau while State of state of cau while State of state of state of the state Geophys. Ros. | ctt., Paper 8011735

Pianetology

SEID Atmospheres of planets SCUATORIAL AKOMALY IN THE JOVIAN IONOS-PHERE

A.K. Manajeo (Strional Physical Laboratory, New Delhi, 110 ONE, India)
The shedron doncontration data from
Ploner 10 and is and Voyager 1 and B
indicate the presence of equatorial
anomaly in the Joylan ioncapture, with
the peak electron consustration value
showing a minimum near the aquetor.
(Pionoer 10 and 11, Voyagor 1 and 2;
equatorial enemaly, Josian ioncaphere).
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SPANIAL COLOR VARIATIONS IN THE VOLCANIC FITMS AT LOXI, ON 10
Sewart A. Colfins (Jat Propolation Lab., Calit, Inst. of Tach., Fasadapa, Calit.)
Nulticofor Voyager 1 photoaraph of the Loki vofenie pluma, on 10, indicate that the photocomists of two particle populations, one with redux 0,001 us -0,01 us and a estoid with radius . | us. The population of tailer particles includes most of the particulate saws in the planiths work increases the previously satisfated particulars was and suggest that SO, gas, observed over Loki farsts, say represent transient line from the vofesco bereat of an emosphere in stable says librium with the surface. (10, Parliculates around Jupilar), Almonohers — [04) Lates around Jupiler, Atmosphers - lo.)

6599 Pionetology-General of Fiscal mesus INC . The Cappil Propert In Libiant and F. Gengle, belging the selection Section of Patrophysique de Maudon, 121 Pi Mealing

Secijon d'Astrophanique de reseaux.

By using the high resmittion observances ut
lencty observatory, no have been ablu to identif,
the 5-tures evaluation on the Finantar, Radio Astransmy (PRA) retards of Voyager, for as shot,
that the 5-bures occur in the regions of the
fy _PPL of and 15-foR and 5-foR' regional. In
these regions in 5-bures e-lesion is extended
into a pattern of topatities features drifting
regetively. These restures tould be inco-slots
vories ists orce, we show that the 5-bures patrem is distinct from the cellars of it is locatitrained amission. These results are discussed in
the frace of Soldstein and Thioran's are -Net.
d. Geophys. Ass., Blue, Peper BOA1712

Seismology

6950 Selemit tourcet Inschenieus, magnitude, fre-quency spectrus, space, and time distri-bution? EARTHQUAKE FOCAL MECHANISMS AND TECTUMIE 240-CESSS OLDIE THE SOUTHERN COUNDARY OF THE CAREF-STAN MATER

CESES SIGNET TRE SOUTHERS SQUARES OF THE BEAST PLATE.

A. I. Kasha Lieuni-Dobarty Geological Obtervatory of Columba Deliversity, Palibades, New York 10961) and D. J. Westers The local webticios of five small americant 16.9 s. 5.61 that occurred in northwestern reseased have been described using televented by the several participation of the Street St placeant of the Caribbean plate with respect to the South American plate is being accessedated slowe war loosy to rised strike-slip isulting appears to occur slong strike-slip feutring appears to occur slong strike-slip feutring appears to occur slong scenes of westmens such as the Second Solt, and the restinguakes trudled new are ell consistent with an emer-work truding compressive stress field being released slong theme among all westmens. These is the plate of the second scenes of the second to relative plate mation per se. Thus, the could be relative plate mation per se. Thus, the could set west simple plate boundary (i.s. transform feutring pressing renter, or subduction some). Instant relative plate motion in this region appears to be accommodated by interest deformation within a broad arom actualism plate motion for the Caribbean plate into northern South Americae. Floral methods series a series was a plate tectnice, Caribbean series and series was plate tectnice. besal J. Geophya. Ros., Sod, Paper 8051674

6970 Structure of the crust and upper manyle SDUBANYARY AND CRESTAL VELOCITYES IN THE ROWELLAN-CEPENLAD SEL A.H. bybre (Department of Coology, University of Delo, Sorway) and O. Lidhole Extraction and vide-angle reflection vefoction. From the ucconfic crust sed the overlying andleants in the Norwellan-Crustled Son'shave here analysed. There is a refer lyoly rapid increase malysed, There is a refer lyoly rapid increase in the Norwellan-Crustled Son'shave here analysed. There is a refer lyoly rapid increase malysed, there is a restricted to the part of the same sequence. The sentative of the balls endured in sequence. The createst here of the balls, have patientary high veided by gradients, 71 and 37 and 18 replaced by the high gradient in the north-causers Graenised Son is associated with the sheep-rifed stagin of Evalvade. Relatively high ass floor sediment mound vefocities sen typical of the Narvegles-Creatien and Son's Professional Son's The Createst veilocities in the Horse-Public son's the Createst veilocit

Sea ares 3.88(2A), 5.18(2B), e.05(2C), 5.6b(3), and 7.80(4) bafe. Layer 2A is say dependent and has not been observed on crust older than 16 m.y. The model is not representative of the upperment crust mast the active apprehing area where one has to introduce additional layers or assert, continues velocity classes with death. tinunus velocity changes with depth.
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Solar Physics, Astrophysics. and Astronomy

Manufactic fields
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Sciences, Understone Orientarity, Logar, Undel
M.E. Montde, C. Austreams, R.L. Hampson
A rederonation of the constant equation for
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to a countrol which describes the behavior of
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This correction which describes the behavior of
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